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FLOOD INSURANCE STUDY

SKAGIT COUNTY, WASHINGTON
UNINCORPORATED AREAS

REVISED: SEPTEMBER 29,1989

Federal Emergency Management Agency

COMMUNITY NUMBER - 530151

NOTICE TO
FLOOD INSURANCE STUDY USERS

Communities participating in the National Flood Insurance Program have established repositories of flood hazard data for floodplain management and flood insurance purposes. This Flood Insurance Study may not contain all data available within the repository. It is advisable to contact the community repository for any additional data.

This publication incorporates revisions to the original Flood Insurance Study. These revisions are presented in Section 9.0.

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Flood Boundary and Floodway Map

PUBLISHED SEPARATELY:

Flood Insurance Rate Map Index
Flood Insurance Rate Map

FLOOD INSURANCE STUDY
SKAGIT COUNTY, WASHINGTON (UNINCORPORATED AREAS)

1.0 INTRODUCTION

1.1 Purpose of Study

This Flood Insurance Study investigates the existence and severity of flood hazards in the unincorporated areas of Skagit County, Washington, and aids in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. This study has developed flood risk data for various areas of the community that will be used to establish actuarial flood insurance rates and assist the community in its efforts to promote sound floodplain management. Minimum floodplain management requirements for participation in the National Flood Insurance Program (NFIP) are set forth in the Code of Federal Regulations at 44 CFR, 60.3.

In some states or communities, floodplain management criteria or regulations may exist that are more restrictive or comprehensive than the minimum Federal requirements. In such cases, the more restrictive criteria take precedence and the State (or other jurisdictional agency) will be able to explain them.

1.2 Authority and Acknowledgments

The sources of authority for this Flood Insurance Study are the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973.

The hydrologic and hydraulic analyses for this study were performed by the U.S. Army Corps of Engineers (COE), Seattle District, and Dames & Moore, for the Federal Emergency Management Agency (FEMA), under Inter-Agency Agreement No. IAA-H-7-76, Project Order No. 13, and Contract No. EMW-C-0542. This study was completed in December 1982, and covers Skagit County with the exception of Swinomish Indian Reservation; the Towns of Concrete, Hamilton, La Conner, and Lyman; and the Cities of Anacortes, Burlington, Mount Vernon, and Sedro Woolley.

1.3 Coordination

An initial coordination meeting was held in Mount Vernon, Washington, on November 20, 1975, between representatives of the study contractor, FEMA, the Washington State Department of Ecology, and Skagit County to inform the county of the nature and purpose of the Flood Insurance Study, to solicit map data, and to establish the scope of the study. Additional coordination on the scope of the study and study methods was conducted with representatives of the county, the study contractors, and FEMA throughout the study period.

An intermediate coordination meeting was held on March 21 and 23, 1983, and was attended by representatives of FEMA, the study contractors, and the county to discuss the study. No major problems were encountered, and the study was acceptable to the county.

The final community coordination meeting was held on June 14, 1984, and was attended by representatives of FEMA, the study contractor, and the county. There were no problems raised that would effect the content of the Flood Insurance Study.

2.0 AREA STUDIED

2.1 Scope of Study

This Flood Insurance Study covers the unincorporated areas of Skagit County, Washington. The area of study is shown on the Vicinity Map (Figure 1).

Areas that were studied by detailed methods are listed as follows:

Skagit River Delta	Overbank Flowpath 1 Overbank Flowpath 2 Overbank Flowpath 3 North Fork Skagit River South Fork Skagit River Main Stem Skagit River
Skagit River	From State Highway 9 bridge at River Mile (RM) 22.5, near Sedro Woolley, to boundary of Ross Lake National Recreation Area at Bacon Creek, RM 82.3
Cascade River	From confluence with the Skagit River to upper end of Cascade River Park at RM 5.8
Sauk River	From confluence with the Skagit River to Skagit-Snohomish County line, RM 17.0
Suiattle River	From confluence with the Sauk River to RM 5.1 and from RM 10.6 to Skagit-Snohomish County line, RM 12.2
Samish River	From the Skagit River delta at RM 8.50 to Skagit-Whatcom County line, RM 26.0
Baker River	From confluence with the Skagit River to RM 0.9

FIGURE 1

FEDERAL EMERGENCY MANAGEMENT AGENCY

SKAGIT COUNTY, WA
(UNINCORPORATED AREAS)

APPROXIMATE SCALE

16 0 16 32 48 MILES

VICINITY MAP

Tidal flooding from Burrows, Skagit, Similk, Samish, Padilla, and Fidalgo Bays, Rosario Strait, and Bellingham, Swinomish, and Guemes Channels affecting mainland shorelines and Allans, Burrows, Cypress, Hope, Goat, Guemes, Ika, Sinclair, Vendovi, Hat, and Samish Islands was also studied by detailed methods.

Rivers and lakes studied by approximate methods are listed as follows:

Suiattle River	From RM 5.1 to RM 10.6.

Lake Campbell, Lake Erie, Lake Cavanaugh, Lake McMurray, Beaver Lake, Clear Lake, and Big Lake.

The areas studied by detailed methods were selected with priority given to all known flood hazard areas and areas of projected development or proposed construction through 1987.

Approximate analyses were used to study those areas having a low development potential or minimal flood hazards. The scope and methods of study were proposed to, and agreed upon by, FEMA and Skagit County, Washington.

2.2 Community Description

Skagit County, in northwestern Washington State, is bordered by Puget Sound on the west and the rugged Cascade Range, rising to 8,000 feet, on the east. It is surrounded by Whatcom County to the north, Okanogan and Chelan Counties to the east, Snohomish and Island Counties to the south, and San Juan County to the west. The county encompasses 1,735 square miles. The first permanent white settlers were established on Fidalgo Island in the late 1850s. Settlement of the tide flats on the mainland soon followed. Clearing and diking of the tide flats created rich farmlands which yielded fine crops of grains and vegetables. In the 1870s, there was a rapid influx of families to the region; schools, churches, and other signs of civilization soon followed. By the 1890s, farming, logging, and commercial fishing activities were well established. Skagit County was established in 1884 and named after the river and the Skagit Indian Tribe which lived along the riverbanks (Reference 1).

In 1979, the population of the county was estimated at 59,900, with a population density of approximately 35 persons per square mile. The distribution of population in 1979 was 32,503 in the incorporated areas and 27,397 in the unincorporated areas. The population increased to 32,112 in the unincorporated areas in 1980. Total population in 1980 was 64,138. The largest city in the county is Mount Vernon, the county seat, which had a population of 13,009 in 1980 (References 2 and 3). Skagit County supports a variety of economic activities including: agriculture, manufacturing, trade, services, government, and fishing. Economic

statistics for Skagit County in 1975 showed that the county had 86,600 acres of highly productive cropland; 567,000 acres (15,082 million board feet) of classified commercial forest land; the largest reserve of limestone in western Washington, estimated at 500 million tons; and coal reserves estimated at approximately 507 million tons (Reference 4).

Floodplain soils consist of sands and gravelly sands in the upper reaches, becoming progressively finer textured to fine sandy loams, silt loams, loams, clay loams, and silty clay loams in the lower reaches. Peat and muck occur in many small drainage basins (Reference 5).

Overstory vegetation in the mountains and foothills of eastern Skagit County is dominated by western hemlock and Douglas fir. Moving westward, many different deciduous trees and shrubs are mixed with conifers, including alder, maple, willow, and cottonwood. The broad floodplain in the western part of the county and the delta is predominantly cultivated land or pasture. Urban areas contain scattered conifers, deciduous trees, shrubs, and grasses (Reference 5).

Maritime airmasses, prevailing westerly winds, and extreme terrain relief cause marked differences in temperature and precipitation across Skagit County. In the low-lying western portions of the county, the climate is mild, without extremes of temperature and precipitation, with average annual precipitation between 5 and 45 inches and average monthly temperatures between 39°F (January) and 69°F (August). In the eastern portions of the county, average annual precipitation ranges between 5 and 150 inches and average monthly temperatures range between 27°F (January) and 63°F (August). Approximately 75 percent of the precipitation in Skagit County falls from October through March. The snowpack in the higher elevations generally remains until late spring or early summer. The average annual snowfall varies from over 500 inches at Mount Baker Lodge (elevation 4,150 feet) to less than 6 inches at Anacortes in the extreme western portion of the county (Reference 6).

The Skagit River is the principal river in Skagit County and is the largest river in the Puget Sound area. It rises in Canada and flows southwesterly approximately 163 miles (90 miles in Skagit County) to Skagit Bay, an arm of Puget Sound, draining approximately 3,133 square miles, including 380 square miles in Canada. Approximately 8 miles above the mouth, the Skagit River divides and discharges through two distributaries, the North and South Forks. The major tributaries of the Skagit River in Skagit County are the Cascade, Sauk, and Baker Rivers, which join the Skagit River at the communities of Marblemount, Rockport, and Concrete, respectively. Two other major rivers in Skagit County are the Suiattle River, a tributary of the Sauk River, and the Samish River, which originates in the low mountains south of Bellingham in Whatcom County and discharges into Samish Bay at Edison.

The Skagit River Valley, upstream from Sedro Woolley to Concrete, is generally from 1 to 2 miles wide and includes many farms and the Towns of Lyman and Hamilton. A large recreational subdivision called Cape Horn has been developed on the left bank approximately 4 miles downstream from the Dalles Bridge at Concrete. Approximately two-thirds of the bottom land in this reach is uncleared or occupied by river channels and sloughs. Upstream from Concrete, the valleys are narrower and less developed. West of Sedro Woolley, the Skagit River Valley becomes a broad delta more than 15 miles wide which extends west through the Cities of Burlington and Mount Vernon and the Town of La Conner.

Major industries in the floodplain are based on agriculture, forest products, and manufacturing (Reference 7).

2.3 Principal Flood Problems

Flooding problems occur from high-tide levels in Skagit Bay or from major floods on the Skagit River and its tributaries.

Tidal flooding can occur when a high astronomical tide (gravitational effects of the sun and moon) is heightened by a large storm surge (rise in water levels due to wind stress and low atmospheric pressure). Wave runup is a significant factor in areas where the shorelines are not sheltered from local wind effects.

Major floods of the Skagit River and its tributaries are caused by winter rainstorms. The Skagit Basin, lying directly in the storm path of cyclonic disturbances from the Pacific Ocean, is subject to numerous storms, which are frequently quite severe. Not uncommon are two or more storms in rapid succession, sometimes less than 24 hours apart. Rain-type floods usually occur in November or December, but may occur as early as October or as late as February. These floods are characterized by sharply rising river flows, high magnitude peaks, and flood durations of several days. Often, heavy rainfall is accompanied by snowmelt which increases the runoff. On the mountain slopes, storm precipitation is heavy and almost continuous as a result of combined frontal and orographic effects.

Spring floods also occur on the Skagit River and its tributaries and are due primarily to snowmelt runoff. However, these events are not of sufficient magnitude to be a serious flood threat. Earlier levee construction was to provide protection from spring floods which permitted farmers to plant earlier. These levees were subsequently improved to also provide more winter protection.

The Skagit River represents the major flooding source of the delta area. Flooding occurs from multiple levee failures and bank and levee overtopping during a 100-year flood. Downstream of Sedro

Woolley, the Skagit River flows through a large delta area that fronts Samish, Padilla, and Skagit Bays. Within this area, the floodplain forms a large alluvial fan with an east-west width of approximately 11 miles and a north-south width of 19 miles (Figure 2).

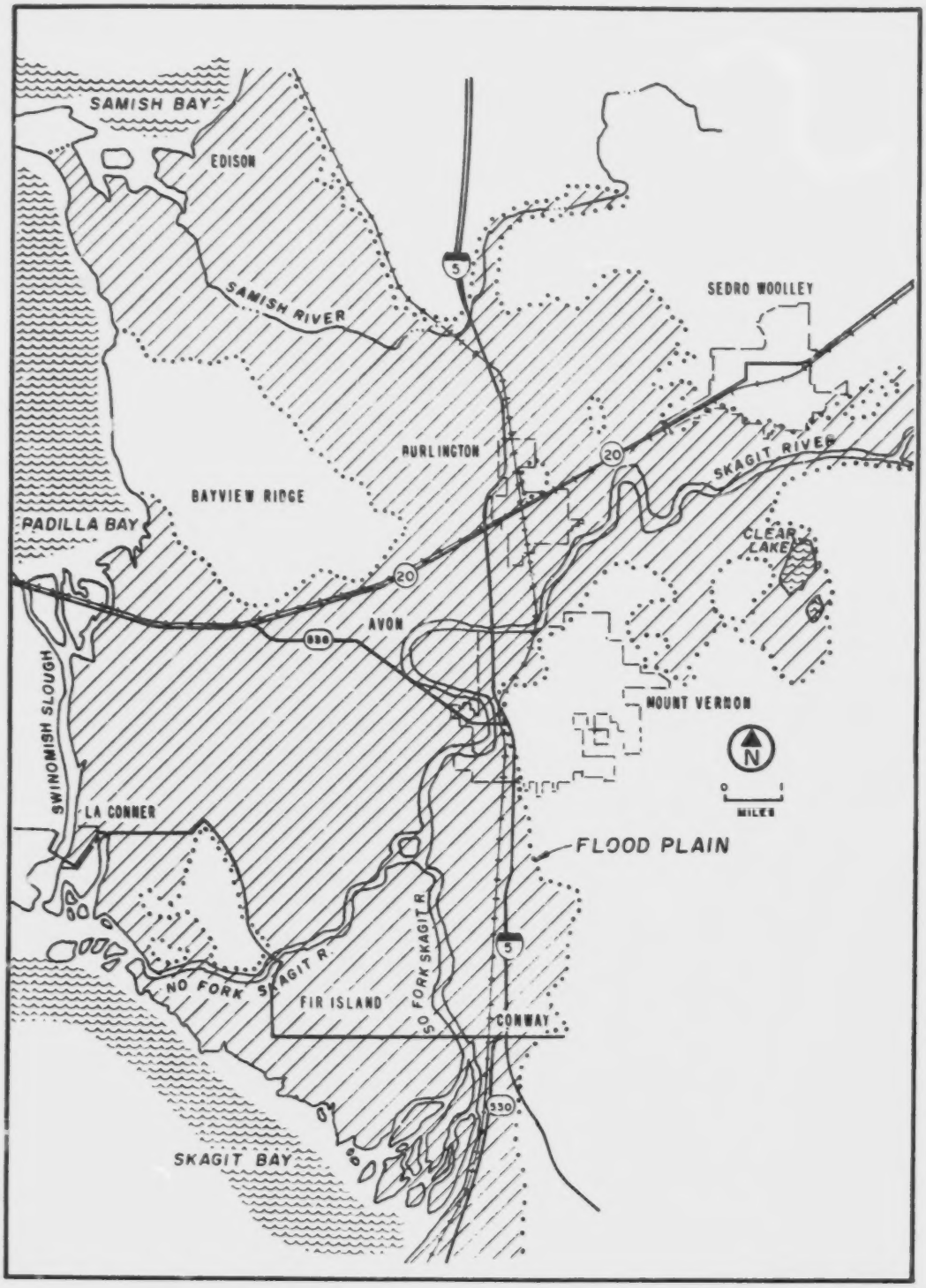
The five most severe floods and the corresponding peak discharges near Sedro Woolley since 1908, when stream gaging in the Skagit River Basin began, are as follows:

November 1909 - 220,000 cubic feet per second (cfs)
December 1917 - 195,000 cfs
December 1921 - 210,000 cfs
November 1949 - 140,000 cfs[1]
February 1951 - 150,000 cfs[1]

[1]Estimated by the COE

Prior to the period of record, two floods occurred that far exceeded any of the floods of record. In 1923, J.E. Stewart of the U.S. Geological Survey (USGS) collected data for and partially completed a report on floods in the Skagit River Basin. The data collected and conclusions reached, together with information concerning floods of record through 1957, are published in USGS Water Supply Paper 1527 (Reference 8). After careful study and analysis of all data available, Stewart reached the conclusion that two great floods occurred prior to the arrival of white settlers and that the earlier and greater of these two floods probably was as large or nearly as large as the greatest flood that has occurred here within the last several hundred years. This flood is estimated to have occurred around 1815. Flood discharges as determined by Stewart for a number of historical floods, together with the maximum floods of record, are presented for various stream gage locations, as follows:

	Record Flows		Historic Flows	
	Discharge (cfs)	Date	Discharge (cfs)	Date
Cascade River at Marblemount	18,700	Nov. 20, 1962	46,000	1815
Suiattle River above Big Creek near Darrington	29,700	Dec. 4, 1975		
Suiattle River near Mansford	30,700	Nov. 27, 1949		
Sauk River near Sauk	82,400	Nov. 27, 1949		
Skagit River near Concrete	154,000	Nov. 27, 1949	500,000	1815
Skagit River near Sedro Woolley	220,000	Nov. 30, 1909	400,000	1815
Skagit River near Mount Vernon	144,000	Feb. 11, 1951	180,000	1906
Samish River near Burlington	5,830	Dec. 28, 1949		



EXISTING CONDITIONS 100-YEAR FLOODING
FIGURE 2

Another significant flood was that of December 1975. Heavy rain began over western Washington late on November 29 and early on November 30. It did not moderate at most precipitation stations until midnight on November 30. Snow had begun falling over the Cascades late on November 24, and the rate of fall became increasingly heavy as the warmer air arrived. By the afternoon of November 30, the snow had changed to heavy rain. Precipitation continued throughout the next 3 days, surging between moderate and heavy. The total storm period of late evening on November 29 to early morning on December 4 included three distinct storms following each other in close succession. Total storm precipitation for the period November 29 through December 5 at Ross Dam, Upper Baker Reservoir, and Stampede Pass was 12.78, 11.90, and 18.79 inches, respectively. Maximum 24-hour precipitation was 4.10, 3.24, and 6.75 inches, respectively. The maximum recorded discharge at Mount Vernon was 129,200 cfs at 7:30 p.m. on December 4. The river was above zero damage stage for 87 hours and above major damage stage for 67 hours. The 1975 flood was essentially a bankfull flood with little or no freeboard. Only extensive flood fighting enabled the levee system to contain the 1975 flood, which had a recurrence interval of approximately 12 years.

On December 15, 1977, the coastal portions of Skagit County were subjected to an extremely high tide which approached a 100-year frequency event. The tide was accompanied by strong west winds and low barometric pressure. The following newspaper account from the Anacortes American (Anacortes, Washington) describes the December 15, 1977, tidal flood in Skagit County:

> The tide spilled water over the dike at Edison, flooding the main road through town. The north end of La Conner was particularly hard hit by the tide. City road crews worked through the morning sandbagging and dumping dirt along First Avenue beside the Swinomish Channel in an attempt to stop the flow of water. The flood water nearly burst the pipes at the La Conner sewage treatment plant.

Photographs of some of the effects of some past Skagit River floods are shown in Figures 3 through 11.

2.4 Flood Protection Measures

The City of Seattle (Seattle City Light) owns and operates Ross Reservoir on the upper Skagit River, the only project on the main stem of the Skagit River with available flood storage. Ross Reservoir has 1,052,300 acre-feet of usable storage between elevations 1,602 and 1,475 feet, of which 120,000 acre-feet are reserved for flood control in compliance with the Federal Energy Regulatory Commission license.

Puget Power operates two hydroelectric power projects on the Baker River: Lower and Upper Baker Dams and Reservoirs located at RMs 1.12 and 9.29, respectively. The Baker River streamflows have

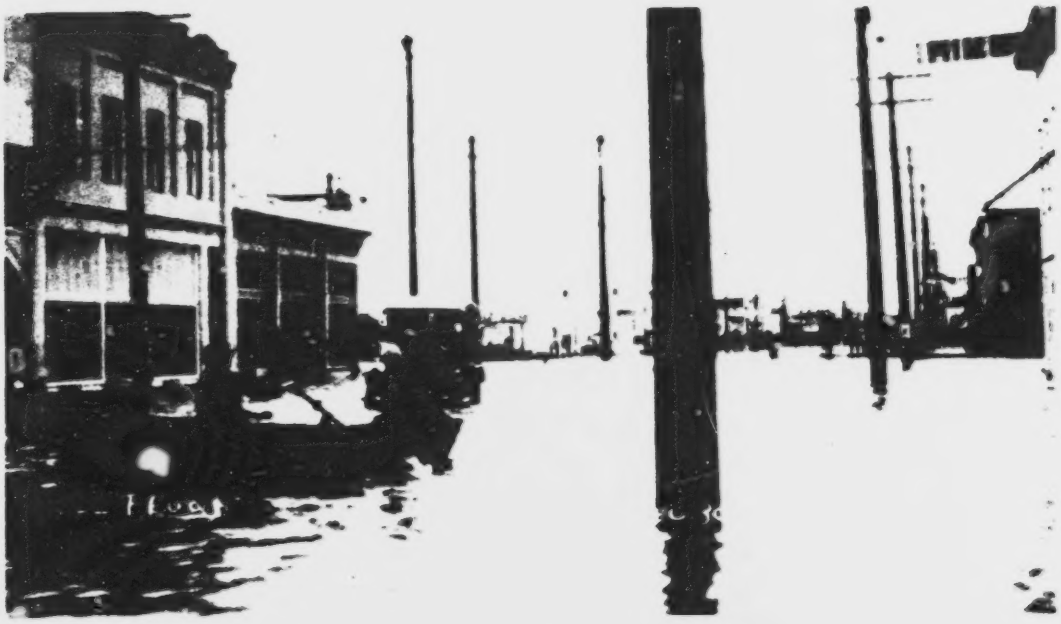


Figure 3. December 1917 Flooding of the Skagit River Along Fairhaven Avenue, in Burlington

Figure 4. December 1921 Floodwater Flowing Over Road Between Burlington and Bayview Ridge, Looking East Toward Burlington

Figure 5. December 1921 Flooding of the Skagit River at Mount Vernon, Looking West Toward West Mount Vernon

Figure 6. Top of Auto in 5 Feet of Water at Fir Island Farm During November 1949 Flood of the Skagit River

Figure 7. February 1951 View of Flooded Area Between Burlington Bend and Burlington, Looking Upstream

Figure 8. February 1951 Flooding of the Skagit River and Levee Failure at Conway, Washington

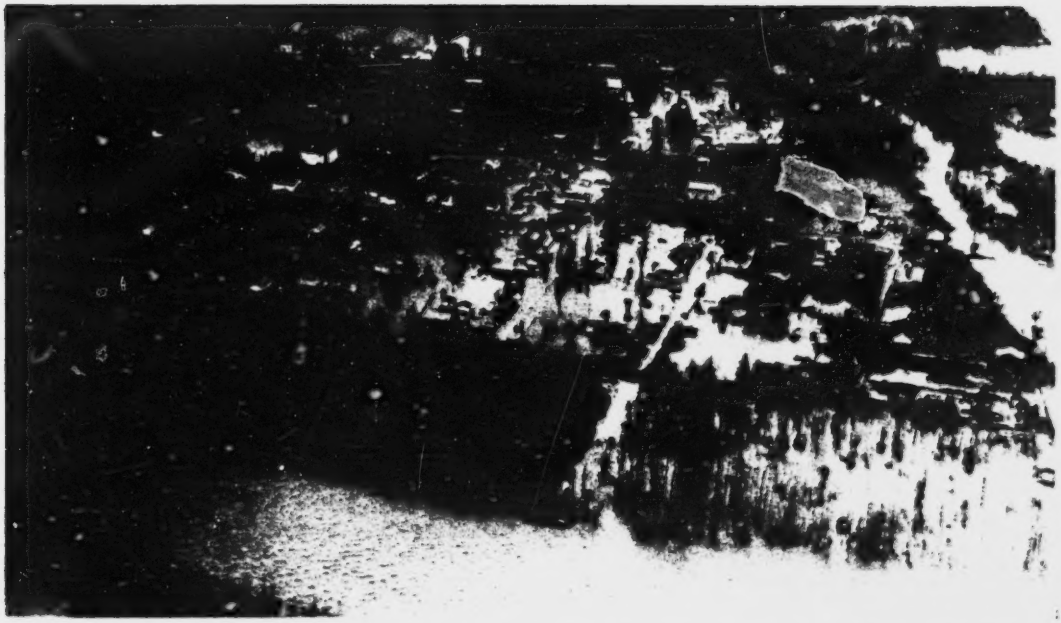


Figure 9. December 1975 Flooding of the Skagit River at Hamilton, Looking North

Figure 10. December 1979 Flooding of the Skagit River at Cape Horn, Looking North

Figure 11. December 1979 Flooding of the Samish River, Looking West Toward Samish and Padilla Bays

subject to varying degrees of flood-control regulation since completion of the Lower Baker Dam project in 1927 and the Upper Baker Dam project in 1959. Flood-control storage was increased in 1977 from 16,000 to 74,000 acre-feet at the Upper Baker project to more effectively regulate the Skagit River flows west of Concrete.

During the November through March flood season, flood-control regulation commences when the flow in the Skagit River near Concrete is forecast to reach or exceed 90,000 cfs within the next 8 hours. The COE then directs operation of the Ross and Baker projects flood-control operations. Project releases are selected with reference to formal operating plans which consider flow at Concrete, reservoir pool elevations, and observed and forecast reservoir inflows. Releases from both projects are regulated to minimum levels until the flood peak has passed and the Skagit River has begun to recede at Concrete. Subsequently, project discharge is increased to draft storage from the reservoirs so that flood-control storage space is regained. A list of storage data for the major dams within the basin is shown on Table 1.

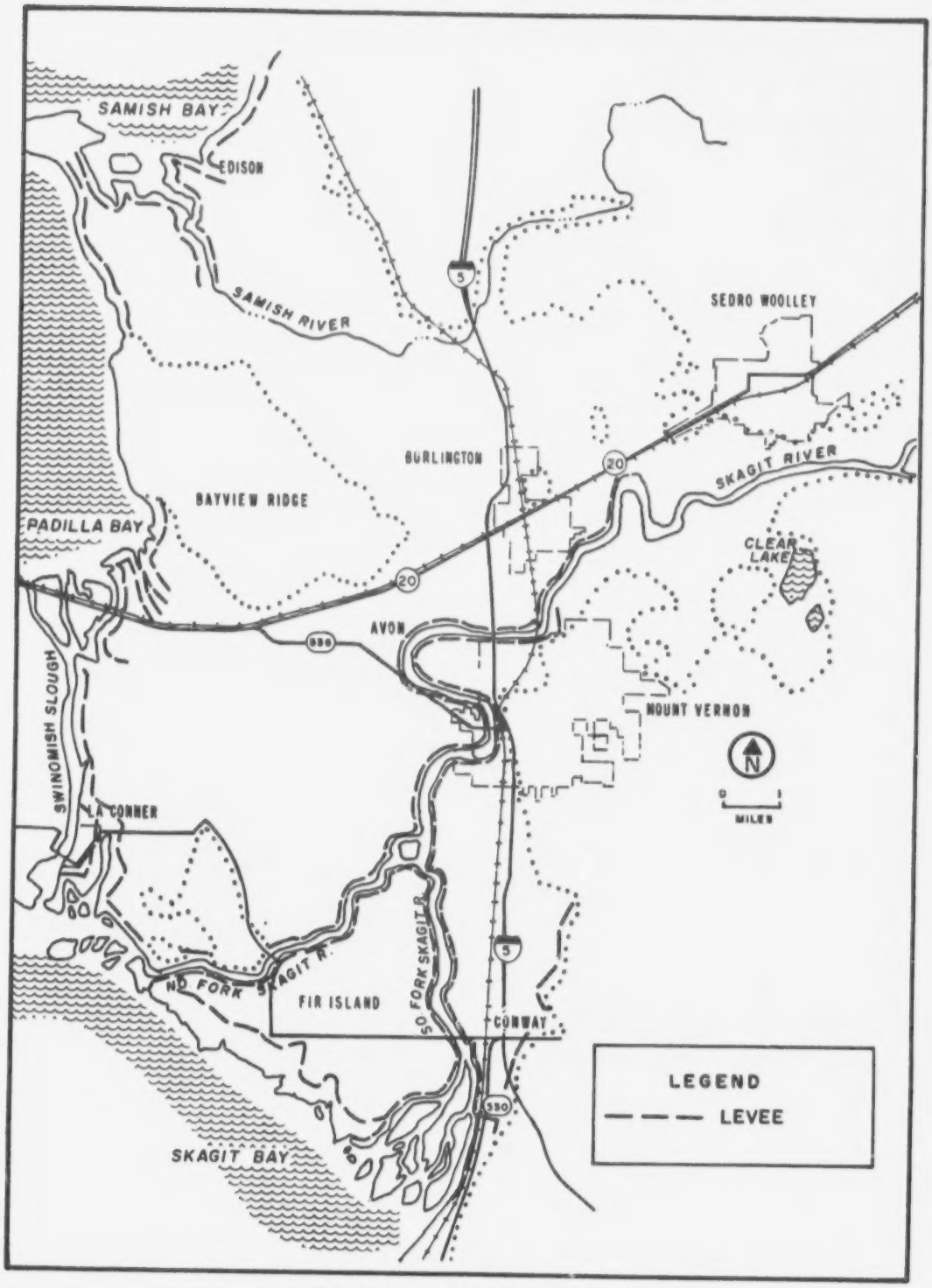
Sixteen diking districts maintain approximately 56 miles of levees and 39 miles of sea dikes in the Skagit River delta. Additional levees protect farmland and residences elsewhere in the county, but none of the levees or dikes are adequate to protect against a 100-year tidal or riverine flood (Figure 12).

3.0 ENGINEERING METHODS

For the flooding sources studied in detail in the county, standard hydrologic and hydraulic study methods were used to determine the flood hazard data required for this study. Flood events of a magnitude which are expected to be equaled or exceeded once on the average during any 10-, 50-, 100-, or 500-year period (recurrence interval) have been selected as having special significance for floodplain management and for flood insurance rates. These events, commonly termed the 10-, 50-, 100-, and 500-year floods, have a 10-, 2-, 1-, and 0.2-percent chance, respectively, of being equaled or exceeded during any year. Although the recurrence interval represents the long term average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than 1 year are considered. For example, the risk of having a flood which equals or exceeds the 100-year flood (1-percent chance of annual exceedence) in any 50-year period is approximately 40 percent (4 in 10), and, for any 90-year period, the risk increases to approximately 60 percent (6 in 10). The analyses reported herein reflect flooding potentials based on conditions existing in the county at the time of completion of this study. Maps and flood elevations will be amended periodically to reflect future changes.

Table 1. Storage Characteristics of Existing Reservoirs

Reservoir	Flood-Control Storage (Acre-Feet)	Maximum Storage (Acre-Feet)	Maximum Usable Storage (Acre-Feet)	Storage Began
Ross	120,000	1,434,800	1,052,300	March 1940
Diablo	0	90,140	76,220	October 1929
Gorge	0	8,485	6,770	June 1960
Upper Baker (Baker Lake)	74,000	285,470	220,630	July 1959
Lower Baker (Lake Shannon)	0	Unknown	142,600	November 1925



EXISTING LEVEE SYSTEM
FIGURE 12

3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish the peak discharge-frequency relationships for each flooding source studied in detail affecting the county.

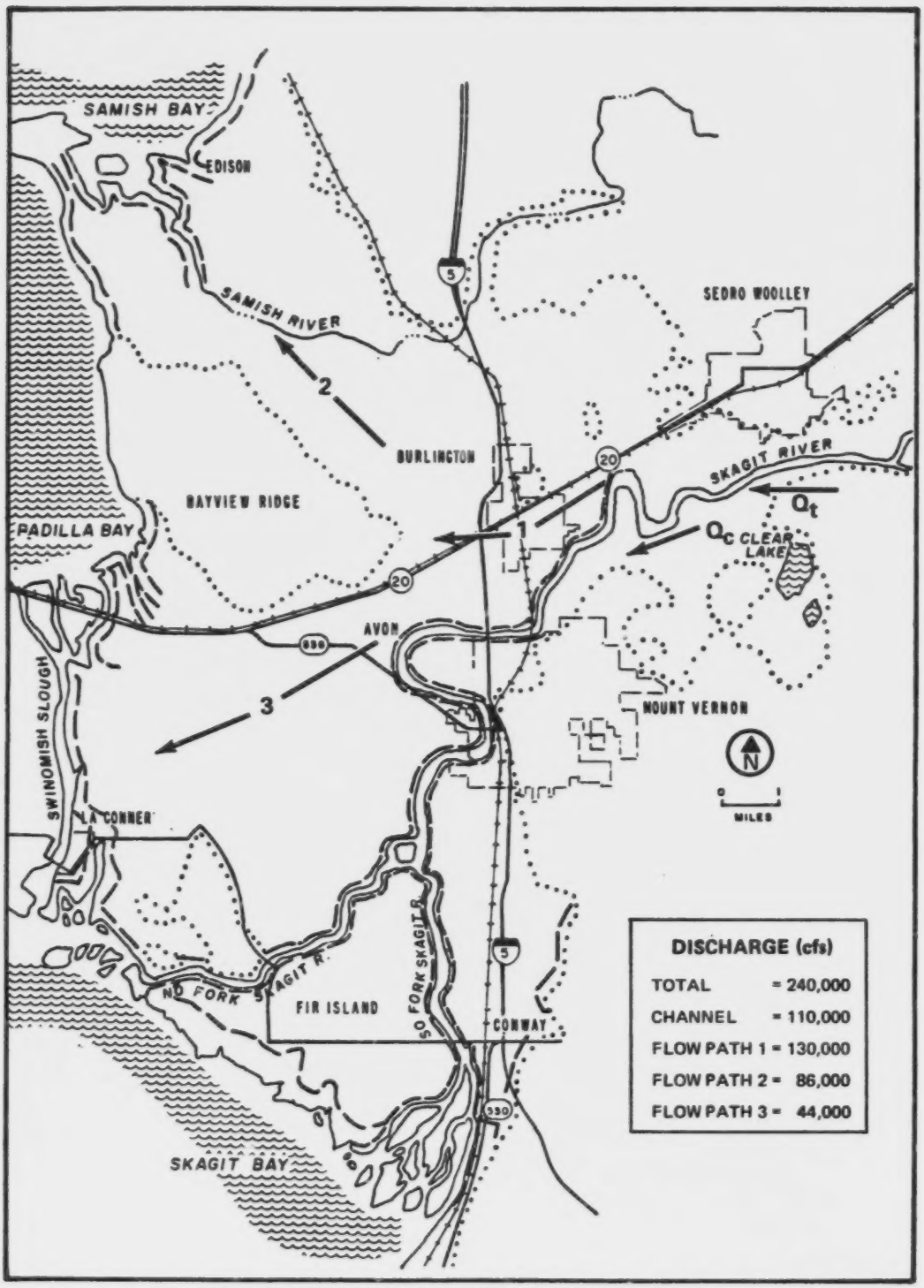
The 100-year flood discharge from the Skagit River downstream from Sedro Woolley was estimated to be 240,000 cfs by the COE (Reference 9). In analyzing overbank flooding without consideration of the levees, a discharge of 110,000 cfs was estimated to be carried by the Skagit River channel with the remaining 130,000 cfs in the overbank areas. Downstream of Sedro Woolley, the flow is divided into channel and overbank flows above the upstream end of the levee system near Sterling. From this point, the overbank flooding flows past Burlington and again divides to flow through the Samish River floodplain into Padilla Bay and through the Skagit River floodplain into Swinomish Slough and Skagit Bay.

Because of the complex nature of the divided overbank floodflows, it was necessary to perform several HEC-2 analyses (Reference 10) for a range of discharges along each path. The results were used to develop stage-discharge rating curves for each path. From these rating curves, discharges were selected for each path; the discharges produced a common elevation at the point of bifurcation of the two paths. It then was determined that 86,000 cfs will flow into Samish and Padilla Bays, and 44,000 cfs will flow into Skagit Bay (Figure 13).

In analyzing the Skagit River and overbank flooding with consideration of the levees, it was determined that 130,000 cfs would be contained by the Skagit River channel and levees. This was the carrying capacity as recorded during the 1975 flood. Overbank flows resulting from levee overtopping, breaching, and external drainage were not quantified. Sheetflow conditions accompanied by high velocities can be expected to occur along the outside of the levees during overtopping and breaching.

The USGS gaging stations: Skagit River near Concrete, Skagit River near Sedro Woolley, and Skagit River near Mount Vernon were the principal stream gaging stations used to establish the various floodflow frequencies necessary for this study. Additional data from other USGS stream gages within the Skagit River Basin and supplemental flow data supplied by Puget Power and Seattle City Light were also used in the analyses. Methodology used in preparation of the various discharge-frequency curves was consistent with the guidelines shown in Bulletin 17A developed by the Hydrology Committee of the U.S. Water Resources Council (Reference 11).

Peak discharge-drainage area relationships for the Skagit, Cascade, Sauk, Suiattle, Samish, and Baker Rivers are shown in Table 2.



DISCHARGE DISTRIBUTION IN DELTA AREA

FIGURE 13

Table 2. Summary of Discharges

Flooding Source and Location	Drainage Area (Square Miles)	Peak Discharges (cfs) 10-Year	50-Year	100-Year	500-Year
Skagit River					
Near Concrete	2,737	124,000	193,000	226,000	329,000[1]
Near Sedro Woolley	3,015	132,000	200,000	229,000	321,000[1]
Cascade River					
At Marblemount	172	14,300	23,800	28,500	41,700
Sauk River					
Near Sauk	714	52,500	81,000	94,000	129,000
Suiattle River					
At Mouth	346	25,800	46,600	58,000	92,000
Samish River					
Near Burlington	87.8	4,670	7,100	11,500	8,300
Baker River					
At Concrete	297	31,500	44,500	51,000	67,000

[1]Decrease Due to Storage Upstream

Elevations for floods of the selected recurrence intervals on Skagit Bay, Swinomish Channel, Similk Bay, Rosario Strait, Burrows Bay, Guemes Channel, and Padilla and Samish Bays are shown in Table 3.

The effects of upstream regulation on discharge-frequency relationships necessitated developing a hydrologic routing model for the Main Stem Skagit River. Discharge data from various observed floods were used to calibrate a computer program developed by the COE, North Pacific Division. The inputs for the program were discharges for Ross Reservoir, the Cascade River, the Sauk River, and the Baker River, plus estimates of local inflow. The resulting computed hydrograph at Concrete was then compared to the actual recorded hydrograph at Concrete for each flood. Appropriate adjustments were made to the model so that the computed hydrograph, on the average, approached the actual observed hydrograph at Concrete. A comparison of four partially observed stage hydrographs at Sedro Woolley was also made to arrive at the proper routing coefficients for the Concrete-Sedro Woolley reach.

Hypothetical unregulated hydrographs contributing to the 10-, 50-, 100-, and 500-year floods at Concrete were developed as a first step in the analysis of effects of regulation by the Ross and Baker projects. The hydrographs contributing to the respective unregulated floods at Concrete were based upon correlations between discharges at Concrete and upstream locations. Hydrographs were developed to represent Ross and Baker project inflow, major tributary discharges, and other local inflows. The adequacy of the contributing inflow hydrographs was verified by comparing the upstream hydrographs routed to Concrete, utilizing the SSARR model (Reference 12), with a corresponding hydrograph based on analysis of observed records at Concrete.

Regulated frequency curves for the Skagit River near Concrete and near Sedro Woolley were based on regulation of the hypothetical 10-, 50-, 100-, and 500-year hydrographs. Regulation of the Ross and Baker Reservoirs was simulated by replacement of the respective unregulated discharge hydrographs in the SSARR model with regulated hydrographs. All other inputs remained unchanged and the flood was then routed through the basin.

Short-term tide records are available at 13 locations in Skagit County, but the nearest long-term record is at Seattle. The Seattle stage-frequency curve was used to determine the 10- and 100-year tide stages at each of the short-term stations by adding the Seattle difference between mean high water (MHW) and the selected recurrence interval to the MHW at each short-term station.

A review of tsunami studies and data indicated that tsunamis are not a significant factor in the coastal flooding of Skagit County.

Table 3. Summary of Elevations

Flooding Source and Location	Elevation (Feet) 10-Year	50-Year	100-Year	500-Year
Skagit Bay				
Southern County Limits to Pull and Be Damned Point	7.8	N/A	8.4	N/A
Pull and Be Damned Point to Hope Island	7.7	N/A	8.2	N/A
Swinomish Channel				
At La Conner	7.4	N/A	8.0	N/A
At Padilla Bay	6.9	N/A	7.5	N/A
Similk Bay				
North of Hope Island and Deception Pass West to State Highway 20	7.9	N/A	8.3	N/A
Rosario Strait				
Deception Pass West of State Highway 20 to Langley Point	6.3	N/A	6.8	N/A
Langley Point to Tide Point on Cypress Island	6.6	N/A	7.1	N/A
Burrows Bay				
Langley Point Through Burrows Pass to Shannon Point on Rosario Strait	6.5	N/A	7.0	N/A
Guemes Channel				
Shannon Point to Hat Island Including Fidalgo Bay	6.7	N/A	7.2	N/A

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Table 3. Summary of Elevations (Cont'd)

Flooding Source and Location	Elevation (Feet) 10-Year	50-Year	100-Year	500-Year
Padilla Bay				
March Point to William Point	6.9	N/A	7.5	N/A
Samish Bay				
William Point to Northern County Limits, Square Harbor On Guemes Island to Northern County Limits, Yellow Bluff on Bellingham Channel to Northern County Limits, and Tide Point on Rosario Strait to Northern County Limits	6.8	N/A	7.3	N/A

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3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of flooding from the sources studied were carried out to provide estimates of the elevations of floods of the selected recurrence intervals.

Water-surface elevations of floods for the selected recurrence intervals for the Skagit River upstream of Sedro Woolley and for the Cascade, Sauk, Suiattle, Samish, and Baker Rivers were computed by Steady Flow Backwater computations using a computer program (722-K5-G311) developed by the COE, Seattle District, which computes both natural and floodway water-surface elevations using the principles of Method II, Engineer Manual 1110-2-1409 (Reference 13).

Water-surface elevations for the 3 overbank flowpaths in the Skagit River delta were computed using the HEC-2 computer program (Reference 10). Use of the computer model was replaced or supplemented with hand calculations in certain areas and situations where such methods were considered to be more suitable.

Backwater models for the rivers studied in detail were calibrated to the following conditions:

a. Skagit River reach from RM 22.53 to 54.10 - 80 percent of the observed water-surface elevations of the December 4, 1975, flood (122,000 cfs near Concrete; 10-year recurrence interval) were reproduced within 0.5 foot, and the majority of the remaining 20 percent within 1.2 feet

b. Skagit River reach from RM 54.10 to 82.23 - 85 percent of the observed water-surface elevations of the December 4, 1975, flood (122,000 cfs near Concrete; 10-year recurrence interval) were reproduced within 1.0 foot

c. Sauk River reach from RM 0.0 to 8.9 - two of the three observed water-surface elevations of the December 4, 1975, flood (65,300 cfs at mouth; 21-year recurrence interval) were reproduced within 1.5 feet

d. Sauk River reach from RM 8.9 to 17.8 - 85 percent of the observed water-surface elevations of the December 4, 1975, flood (65,300 cfs at mouth; 21-year recurrence interval) were reproduced within 0.5 foot, and remaining observed water-surface elevations were reproduced within 1.2 feet, except for one considered to be unreliable

e. Samish River reach from RM 0.0 to 26.0 - 84 percent of the observed water-surface elevations of the December 2, 1975, flood (6,090 cfs near Burlington; 25-year recurrence interval) were reproduced within 0.5 foot, and the majority of the remaining 16 percent within 1.1 feet

Because there are no observed high-water marks for the Suiattle and Cascade Rivers, the models were adjusted with low flow and full-bank flows to obtain a reasonable and smooth water-surface profile. The adjustments were considered satisfactory when no irregularities appeared in water-surface profiles of 10-, 50-, 100-, and 500-year floods.

Water-surface elevations for the North Fork, South Fork, and Main Stem Skagit River were taken from the flood profiles of the 1975 flood (Reference 9).

Flood profiles for the overbank flowpaths were drawn showing computed 100-year flood water-surface elevations (Exhibit 1).

Because levees along the Skagit River do not provide adequate protection from the 100-year flood in accordance with FEMA's levee policy, the analysis for the Skagit delta was performed considering two separate conditions. The first condition assumes that the levees do not exist. Therefore, only the carrying capacity of the channel was considered, with all remaining 100-year flow in the overbank areas. The second condition assumes that the channel and levees carry the amount of flow experienced in the 1975 flood, which was a levee-full condition. Overbank flooding for this condition is due to levee overtopping, breaching, and external drainage problems. In accordance with FEMA's levee policy, the results of the analyses for both conditions have been presented in this report to show the more severe of the two conditions for each area of the delta.

The 100-year flooding for the area located east of the Skagit River between the southern end of Mount Vernon and the coast is caused by a combination of tidal, overland flow, and overtopping and breach of the levees. A field inspection of this area and information obtained from community officials and residents revealed that the portion of the area immediately south of Mount Vernon will be flooded by overland flow in the form of shallow sheetflow of 1-foot depth. The middle portion of the area, between Blackburn Road and Fir Island Road, will be flooded due to levee failure; the remaining area, south of Fir Island Road, will be subjected to tidal flooding. To determine flood elevations for the area, a HEC-2 analysis was performed for a range of discharges with an average levee crest elevation, 8 feet, as the starting water-surface elevation. The discharge which provided a 1-foot depth of flooding in the vicinity of Mount Vernon was adopted and used in conjunction with topographic maps (Reference 14) to determine the depths of flooding for the intermediate area between Blackburn Road and Fir Island Road.

The 100-year flooding for the area located between the North Fork and South Fork Skagit River is caused by overtopping and breach of the levees and tidal flooding. Flooding in the area between

Johnson Road and the confluence of the two forks is due to overtopping of the levees. Depth of flow in this area was approximated. The remaining area south of Johnson Road is subject to tidal flooding.

The overtopping and breach of levees along the Skagit River and its tributaries will result in overland flow with an initial high velocity. This high velocity will occur over a short distance until it merges with the floodwater of lower velocity flowing towards the coast. The high velocity zone starts at the levee and ends at a point where the depth of water is 3 feet. The overland flow velocity was computed for a small section of the levee using Manning's equation, with the energy slope defined as the difference in elevation between top of levee and the point of merge with the main overland flow.

$$V = \frac{1.486}{n} (R)\ 2/3\ (S)\ 1/2$$

$$R = \frac{\text{Cross Sectional Area}}{\text{Wetted Perimeter}}$$

Where: V = Velocity of Flow

n = Roughness Coefficient

R = Hydraulic Radius

S = Hydraulic Gradient

Flooding of the area inside the meander loop, east of Avon, is caused by ponding due to overtopping of the Skagit River levees. The ponding elevation of this area is controlled by the minimum ground elevation of the point of exit from the channel between Interstate Highway 5 and the levee system.

Shallow ponding occurs near Mount Vernon, south of Kimble Road, and between the Skagit River and Britt Slough Road, due to overtopping of levees along the Skagit River. The 100-year elevation used for this area was related to ground-surface elevations to determine the depth of flooding and is controlled by the top of high ground enclosing it.

For detailed study reaches, excluding the delta area, all channel cross sections were field surveyed, and most overbank cross sections were developed photogrammetrically from aerial photographs (Reference 15). Most of the cross sections were determined in 1977, except on the Skagit River downstream of Concrete. On the Skagit River, between Sedro Woolley and Concrete, 10 cross sections determined in 1977 were supplemented with 32 cross sections developed in 1963.

Cross section data for the delta area were obtained from aerial mapping (Reference 16), USGS topographic maps (Reference 17), other topographic maps (References 14 and 18), and as-built drawings of Interstate Highway 5 (Reference 19). Terrain features, such as roads, railroads, and levees, that would have a hydraulic effect were considered by selecting the cross section locations to include and reflect the controlling effects of such features.

Field observations were made to supplement available topographic data.

Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles (Exhibit 1). For stream segments for which a floodway was computed (Section 4.2), selected cross section locations are also shown on the Flood Boundary and Floodway Map (Exhibit 2).

Channel and overbank roughness factors (Manning's "n") were initially based on empirical methods and then adjusted where required during model calibration. Field inspections and photographs aided in the model calibration. Roughness values for all flooding sources, except for the delta overbank flowpaths, varied from 0.030 to 0.050 for the channel and from 0.050 to 0.120 for the overbank areas.

The Manning's "n" values used in the computation of flood profiles for the overbank flows of the delta area were estimated based on review of aerial photographs (Reference 16) and a county land-use map (Reference 20). Values for roughness coefficients ranged from 0.045 to 0.060.

Starting water-surface elevations for the rivers studied in detail, excluding the delta overbank flow paths, were established by the development of a starting rating curve using the coincident discharge of the main stem associated with the event being analyzed on the tributary. It was assumed that the coastal levees would contain the riverine flooding until they were overtopped. Therefore, the average levee crest elevation, 8 feet, was used as the starting water-surface elevation for Overbank Flowpaths 2 and 3. The common upstream elevation of the two flowpaths was used as the starting water-surface elevation for Overbank Flowpath 1.

All bridges were field checked to obtain elevation data and structural geometry.

Geometric data for each bridge and other hydraulic structures were included in the backwater models, and the type of flow and the associated head loss at each structure was computed; no additional obstructions were considered. The flood elevations shown in this study are considered valid only if the structures remain unobstructed, operate properly, and do not fail. Terrain

features, such as roads, railroads, fills, levees, etc., which would have a hydraulic effect, were considered by selecting the cross section locations to include and reflect the controlling effects of such features. No allowances were made in the backwater models for possible sedimentation, aggradation, erosion, or channel changes that might have occurred since the cross section surveys or that might occur in the future.

The analysis indicates that the elevated portions of Interstate Highway 5, west of Burlington, will obstruct this flow from Overbank Flowpath 1 to some extent, but the highway will be overtopped in several locations.

River mile stationing shown on drawings and tables in this report was established by interpolating between key landmarks, such as bridges, for which river mile stationing is specified in the river mile index (Reference 21). Because of channel changes since the index was established, the published distances between index stations do not always scale out on the maps. In such cases, the measured flow line distances between cross sections were used in the backwater computations, rather than the stationing distances.

Due to the extreme meandering nature of streams in the study area, stream distances will not always agree between maps and profiles.

Examination of the backwater analyses for the Cascade River showed that flow conditions are very unstable in the upper two-thirds of the study reach, from cross sections H to S. High velocities and numerous supercritical flow conditions were encountered in this reach. To determine "stable" water-surface elevations in this reach, a factor of 0.4 of the velocity head ($V^2/2g$) was added to the computed critical depth (Dc) water-surface elevations. This is based on the condition that flow must be greater than 1.1 Dc to be stable (Reference 22).

Some areas within the Skagit River delta floodplain lie above the 100-year flood elevations and, therefore, are not subject to flooding; due to the wide expanse and sheetflow conditions that exist throughout the delta area, such areas are shown as Zone B.

Coastal areas of Skagit County are also subject to tidal flooding. A detailed analysis of tidal flooding was conducted for the coastal areas of Skagit County to determine tidal flooding stages for 10- and 100-year recurrence intervals and a wave-runup factor for use in exposed reaches.

According to correspondence dated December 7 and 8, 1983, between the COE, Seattle District and Region 10, the 100-year stillwater elevations (S_{100}) were determined from a tide-frequency curve for the Seattle tide gage by:

$$S_{100}{}_{\text{Location "X"}} = (S_{100}{}_{\text{Seattle}} - MHW_{\text{Seattle}}) + MHW_{\text{Location "X"}}$$

Previous studies indicate an average wave runup of 1.5 feet for moderately exposed reaches in northern Puget Sound.

The Skagit County shoreline was divided into exposed reaches or sheltered reaches and 1.5 feet were added to the 100-year tidal stage for the exposed reaches. In sheltered reaches, no runup factor was added.

Lakes Campbell, Erie, Cavanaugh, McMurray, and Beaver, Clear, and Big Lakes were studied by approximate methods. Field studies were conducted for Lakes Campbell and Erie and floodplain boundaries were determined using information obtained from local residents and approximate analysis of the outlet channels and/or culverts. Floodplain boundaries for the remaining lakes were taken from the published Flood Hazard Boundary Maps and transferred to the work maps (Reference 23).

Approximate flood boundaries for ponds south of Mount Vernon along the western edge of Britt Slough Road were determined using topographic maps (Reference 14) and engineering judgment.

All elevations are referenced to the National Geodetic Vertical Datum of 1929 (NGVD). Elevation reference marks used in this study are shown on the maps.

4.0 FLOODPLAIN MANAGEMENT APPLICATIONS

The NFIP encourages State and local governments to adopt sound floodplain management programs. Therefore, each Flood Insurance Study produces maps designed to assist communities in developing floodplain management measures.

4.1 Floodplain Boundaries

To provide a national standard without regional discrimination, the 1-percent annual chance (100-year) flood has been adopted by FEMA as the base flood for floodplain management purposes. The 0.2-percent annual chance (500-year) flood is employed to indicate additional areas of flood risk in the community. For each stream studied in detail, the 100- and 500-year floodplain boundaries have been delineated using the flood elevations determined at each cross section. Between cross sections, the boundaries were interpolated using topographic maps at a scale of 1:4,800, with a contour interval of 5 feet for the Skagit River upstream of Sedro Woolley; and the Cascade, the downstream end of the Suiattle, the Sauk, and the Baker Rivers (Reference 24). For the upstream end of the Suiattle River, boundaries were delineated using a topographic map at a scale of 1:24,000, enlarged to 1:12,000, with a contour interval of 40 feet (Reference 25). Boundaries were delineated on topographic maps at scales of 1:24,000 and 1:62,500,

both enlarged to 1:4,800, with contour intervals of 20 and 50 feet, respectively, for the Samish River (References 26 and 27). For the Skagit River delta, 100-year floodplain boundaries were delineated using the flood elevations determined at each cross section; between cross sections, the boundaries were interpolated using topographic maps at scales of 1:24,000, with a contour interval of 20 feet (Reference 17); 1:2,400, with a contour interval of 2 feet (Reference 18); and 1:2,400, with a contour interval of 5 feet (Reference 14). Aerial mapping at a scale of 1:24,000, with a contour interval of 100 feet (Reference 16), and construction as-built drawings (Reference 19) were also used in the interpolation.

For Lakes Campbell and Erie, 100-year approximate floodplain boundaries were determined using historic flood elevations and engineering judgment and were delineated on topographic maps at a scale of 1:24,000, with a contour interval of 20 feet (Reference 28).

The 100- and 500-year floodplain boundaries are shown on the Flood Boundary and Floodway Map (Exhibit 2). In cases where the 100- and 500-year floodplain boundaries are close together, only the 100-year floodplain boundary has been shown. Small areas within the floodplain boundaries may lie above the flood elevations but cannot be shown due to limitations of the map scale and/or lack of detailed topographic data.

Tidal flooding boundaries in unleveed areas were derived from inundation maps published in the Coastal Zone Atlas of Washington (Reference 29), which were based on field observations following an extremely high tide in December 1977. The boundaries were delineated on topographic maps at a scale of 1:24,000, with a contour interval of 20 feet (Reference 28). In leveed areas, where the upland areas are subject to flooding from the Skagit River, the levee was used as the boundary between tidal and riverine flooding and rate zones.

For streams studied by approximate methods, only the 100-year floodplain boundary is shown.

Approximate 100-year floodplain boundaries in some portions of the study area were taken directly from the Flood Hazard Boundary Map (Reference 23).

4.2 Floodways

Encroachment on floodplains, such as structures and fill, reduces flood-carrying capacity, increases flood heights and velocities, and increases flood hazards in areas beyond the encroachment itself. One aspect of floodplain management involves balancing

the economic gain from floodplain development against the resulting increase in flood hazard. For purposes of the NFIP, a floodway is used as a tool to assist local communities in this aspect of floodplain management. Under this concept, the area of the 100-year floodplain is divided into a floodway and a floodway fringe. The floodway is the channel of a stream, plus any adjacent floodplain areas, that must be kept free of encroachment so that the 100-year flood can be carried without substantial increases in flood heights. Minimum Federal standards limit such increases to 1.0 foot, provided that hazardous velocities are not produced. The floodways in this study are presented to local agencies as minimum standards that can be adopted directly or that can be used as a basis for additional floodway studies.

The floodways presented in this study were computed on the basis of equal-conveyance reduction from each side of the floodplain. The results of these computations are tabulated at selected cross sections for each stream segment for which a floodway is computed (Table 4).

In June 1981, Skagit County officials requested widening of floodway boundaries in some reaches of the main stem of the Skagit River between Sedro Woolley and Concrete to follow physical ground features. At the direction of FEMA, these changes were made within the unincorporated areas of Skagit County from cross sections D through Q and T through AB; therefore, because the floodway was not generated using HEC-2 methodology, data shown in Table 4 pertain only to the political floodway boundaries.

For the study area downstream of Sedro Woolley, floodplain encroachment must be restricted in certain definitive areas. For the Skagit River proper, the levees confining the channel and adjacent areas have been designated as floodways. In the vicinity of Whitmarsh Road and the old U.S. Highway 99 bridge (Garl Street), the most landward levees were used to establish the floodway boundary. The purpose of these floodway designations is to preclude any encroachment which would reduce the capacity of the river channel or jeopardize the integrity of the levee system.

Conventional floodways are not appropriate for the Skagit River delta area for a number of reasons. Although flood elevation and depth criteria can be established for the delta based on general flood risk assessments that consider possible modes and locations of levee failure in flowpath computations, such analyses are not appropriate for establishing floodways on the delta. Unlike typical valley situations, the exact location of flowpaths during any particular flood event on the delta cannot be known in advance due to the uncertainty of where levee failures will occur, the relative sequence of levee failures, and the volumes of flow that will result. Likewise, because of the topographic nature of the delta, flooding occurs in sheetflow patterns and no one particular

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Skagit River								
A	22.53	4,000	24,392	9.4	45.1	45.1	45.1	0.0
B	23.30	3,048	40,654	5.6	50.1	50.1	50.1	0.0
C	24.10	1,842	31,449	7.3	52.6	52.6	52.8	0.2
D	24.71	4,650	--[2]	--[2]	55.5	55.5	--[2]	--[2]
E	25.20	7,180	--[2]	--[2]	56.6	56.6	--[2]	--[2]
F	26.60	4,870	--[2]	--[2]	58.7	58.7	--[2]	--[2]
G	27.18	5,060	--[2]	--[2]	59.8	59.8	--[2]	--[2]
H	27.61	7,210	--[2]	--[2]	60.2	60.2	--[2]	--[2]
I	28.36	7,420	--[2]	--[2]	61.0	61.0	--[2]	--[2]
J	29.05	9,320	--[2]	--[2]	61.7	61.7	--[2]	--[2]
K	30.10	11,610	--[2]	--[2]	62.9	62.9	--[2]	--[2]
L	31.50	10,450	--[2]	--[2]	67.3	67.3	--[2]	--[2]
M	32.21	7,110	--[2]	--[2]	70.5	70.5	--[2]	--[2]
N	33.34	5,270	--[2]	--[2]	72.4	72.4	--[2]	--[2]
O	34.76	6,060/3,540[3]	--[2]	--[2]	78.6	78.6	--[2]	--[2]
P	36.67	7,850	--[2]	--[2]	88.2	88.2	--[2]	--[2]
Q	37.32	7,990	--[2]	--[2]	89.3	89.3	--[2]	--[2]
R	39.01	5,192	59,790	3.8	97.5	97.5	98.4	0.9
S	39.80	3,536/1,336[3]	43,672	5.2	99.9	99.9	100.9	1.0
T	41.18	2,680	--[2]	--[2]	105.4	105.4	--[2]	--[2]
U	42.43	1,790	--[2]	--[2]	112.5	112.5	--[2]	--[2]
V	43.17	2,240	--[2]	--[2]	117.3	117.3	--[2]	--[2]
W	43.89	930	--[2]	--[2]	120.7	120.7	--[2]	--[2]
X	44.45	2,880	--[2]	--[2]	124.4	124.4	--[2]	--[2]
Y	45.21	4,160	--[2]	--[2]	128.3	128.3	--[2]	--[2]
Z	45.93	2,130	--[2]	--[2]	130.8	130.8	--[2]	--[2]

[1]Miles Above Mouth at Skagit Bay [2]Data Not Available [3]Width/Width Within County Limits

TABLE 4

FEDERAL EMERGENCY MANAGEMENT AGENCY

SKAGIT COUNTY, WA
(UNINCORPORATED AREAS)

FLOODWAY DATA

SKAGIT RIVER

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Skagit River (Cont'd)								
AA	46.88	1,013	17,852	12.7	135.9	135.9	136.6	0.7
AB	47.42	2,170	--[2]	--[2]	140.6	140.6	--[2]	--[2]
AC	48.25	1,558	24,824	9.1	143.6	143.6	144.3	0.7
AD	48.95	1,336	21,783	10.4	146.9	146.9	147.6	0.7
AE	49.39	1,512	20,002	11.3	149.3	149.3	150.2	0.9
AF	49.93	1,269	27,193	8.3	154.0	154.0	154.8	0.8
AG	50.35	1,510	28,750	7.9	155.6	155.6	156.6	1.0
AH	51.08	2,246	43,909	5.1	158.7	158.7	159.7	1.0
AI	51.70	1,731	32,158	7.0	160.5	160.5	161.5	1.0
AJ	52.32	746	20,237	11.2	163.8	163.8	164.7	0.9
AK	52.45	726	17,621	12.8	164.7	164.7	165.5	0.8
AL	52.88	724	18,839	12.0	169.7	169.7	169.9	0.2
AM	53.28	540	17,789	12.7	172.9	172.9	173.2	0.3
AN	53.68	901	25,870	8.7	176.7	176.7	177.1	0.4
AO	54.09	300	13,692	16.5	178.5	178.5	178.8	0.3
AP	54.62	690	20,529	11.0	183.8	183.8	183.9	0.1
AQ	55.25	802	24,883	9.1	186.5	186.5	186.5	0.0
AR	55.79	1,540	42,801	5.3	188.6	188.6	189.1	0.5
AS	56.83	716	20,094	10.2	190.3	190.3	190.9	0.6
AT	57.03	625	19,116	10.8	191.4	191.4	192.3	0.9
AU	57.38	1,428	37,006	5.6	194.5	194.5	195.2	0.7
AV	57.74	2,285	45,936	4.5	195.2	195.2	196.0	0.8
AW	58.16	3,624	66,881	3.1	196.2	196.2	197.1	0.9
AX	58.51	3,746	66,543	3.1	196.6	196.6	197.5	0.9
AY	59.36	2,243	37,078	5.5	198.0	198.0	198.9	0.9
AZ	60.08	2,000	30,589	6.7	200.2	200.2	201.1	0.9

[1]Miles Above Mouth at Skagit Bay [2]Data Not Available

TABLE 4

FEDERAL EMERGENCY MANAGEMENT AGENCY

SKAGIT COUNTY, WA
(UNINCORPORATED AREAS)

FLOODWAY DATA

SKAGIT RIVER

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Skagit River (Cont'd)								
BA	60.57	966	19,142	10.7	202.3	202.3	203.1	0.8
BB	61.04	1,016	18,456	11.1	205.5	205.5	206.1	0.6
BC	61.48	997	21,521	9.6	209.1	209.1	209.9	0.8
BD	61.79	542	16,087	12.8	210.7	210.7	211.5	0.8
BE	62.26	494	16,215	12.7	213.5	213.5	213.8	0.3
BF	62.69	563	17,774	11.6	215.3	215.3	215.7	0.4
BG	63.14	1,150	29,854	6.9	217.4	217.4	218.2	0.8
BH	63.40	1,112	27,194	7.6	217.8	217.8	218.6	0.8
BI	63.87	727	19,015	10.8	218.9	218.9	219.6	0.7
BJ	64.27	823	21,691	9.5	220.9	220.9	221.1	0.2
BK	64.62	1,289	32,553	6.3	222.8	222.8	223.4	0.6
BL	65.15	1,270	31,320	6.6	224.2	224.2	225.1	0.9
BM	65.58	2,280	42,037	4.9	225.8	225.8	226.8	1.0
BN	65.98	1,663	32,493	6.3	227.1	227.1	227.9	0.8
BO	66.52	3,274	61,564	3.3	228.8	228.8	229.7	0.9
BP	67.09	4,000	43,453	4.7	229.6	229.6	230.4	0.8
BQ	67.60	2,385	34,862	2.8	231.5	231.5	232.5	1.0
BR	67.79	2,069	16,407	5.9	231.9	231.9	232.8	0.9
BS	68.21	3,408	45,243	2.1	233.8	233.8	234.7	0.9
BT	68.67	3,355	34,723	2.8	234.7	234.7	235.5	0.8
BU	69.06	4,948	41,971	2.3	235.9	235.9	236.8	0.9
BV	69.37	5,570	46,067	2.1	237.0	237.0	237.8	0.8
BW	69.89	3,438	27,311	3.5	238.7	238.7	239.6	0.9
BX	70.22	1,753	15,058	6.4	241.3	241.3	242.0	0.7
BY	70.63	3,589	21,937	4.4	245.3	245.3	246.1	0.8
BZ	71.02	1,965	11,382	8.4	249.0	249.0	249.9	0.9

[1]Miles Above Mouth at Skagit Bay

TABLE 4

FEDERAL EMERGENCY MANAGEMENT AGENCY

SKAGIT COUNTY, WA
(UNINCORPORATED AREAS)

FLOODWAY DATA

SKAGIT RIVER

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY (FEET NGVD)	WITH FLOODWAY	INCREASE
Skagit River (Cont'd)								
CA	71.44	2,933	22,077	4.3	254.1	254.1	254.9	0.8
CB	71.85	3,248	24,831	3.9	256.4	256.4	257.3	0.9
CC	72.25	3,742	19,433	4.9	261.6	261.6	262.2	0.6
CD	72.60	3,391	34,661	2.8	266.2	266.2	267.2	1.0
CE	73.09	2,688	23,205	4.1	269.5	269.5	270.2	0.7
CF	73.43	1,634	12,868	7.5	274.1	274.1	274.6	0.5
CG	73.67	2,644	14,205	6.8	277.9	277.9	278.1	0.2
CH	74.03	3,536	19,407	4.9	282.8	282.8	283.1	0.3
CI	74.41	3,367	23,963	4.0	286.6	286.6	286.8	0.2
CJ	74.88	1,824	13,661	7.0	290.3	290.3	291.0	0.7
CK	75.18	1,108	13,607	7.1	293.3	293.3	294.0	0.7
CL	75.62	773	9,006	10.7	296.3	296.3	297.2	0.9
CM	76.00	384	6,843	14.0	299.8	299.8	300.4	0.6
CN	76.45	899	11,584	8.3	304.2	304.2	305.2	1.0
CO	76.88	716	9,837	9.8	306.8	306.8	307.7	0.9
CP	77.24	857	10,867	8.8	309.7	309.7	310.6	0.9
CQ	77.68	1,495	18,647	5.1	314.2	314.2	315.1	0.9
CR	78.20	863	10,117	6.1	316.9	316.9	317.9	1.0
CS	78.65	857	8,358	7.4	319.9	319.9	320.6	0.7
CT	79.12	396	6,201	10.0	323.0	323.0	323.9	0.9
CU	79.40	470	7,329	8.5	325.5	325.5	326.2	0.7
CV	79.72	400	5,972	10.4	327.7	327.7	328.1	0.4
CW	80.02	400	6,136	10.1	331.1	331.1	331.3	0.2
CX	80.34	710	8,823	7.0	334.8	334.8	334.9	0.1
CY	80.59	582	7,763	8.0	336.4	336.4	336.5	0.1
CZ	80.81	301	5,114	12.1	337.9	337.9	338.0	0.1

[1]Miles Above Mouth at Skagit Bay

TABLE 4

FEDERAL EMERGENCY MANAGEMENT AGENCY

SKAGIT COUNTY, WA
(UNINCORPORATED AREAS)

FLOODWAY DATA

SKAGIT RIVER

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Skagit River (Cont'd)								
DA	81.13	407	7,112	8.7	341.3	341.3	341.9	0.6
DB	81.40	382	6,192	10.0	343.0	343.0	343.9	0.9
DC	81.77	412	7,621	8.1	346.1	346.1	347.1	1.0
DD	82.00	422	7,445	8.3	347.6	347.6	348.3	0.7
DE	82.23	671	8,390	7.4	349.4	349.4	350.0	0.6

[1]Miles Above Mouth at Skagit Bay

TABLE 4

FEDERAL EMERGENCY MANAGEMENT AGENCY

SKAGIT COUNTY, WA
(UNINCORPORATED AREAS)

FLOODWAY DATA

SKAGIT RIVER

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
						(FEET NGVD)		
Cascade River								
A	0.15	1,550	9,582	3.0	316.3	311.8[2]	312.7[2]	0.9
B	0.37	780	2,814	10.1	317.2	317.2	317.5	0.3
C	0.57	1,377	9,667	2.9	324.6	324.6	324.6	0.0
D	0.90	1,757	3,907	7.3	329.6	329.6	329.7	0.1
E	1.33	579	5,607	5.1	338.6	338.6	339.5	0.9
F	1.55	623	4,490	6.3	340.6	340.6	341.1	0.5
G	1.92	620	3,561	8.0	349.9	349.9	349.9	0.0
H	2.34	1,200	2,130	13.3	370.0	370.0	370.0	0.0
I	2.66	1,060	6,751	4.2	383.2	383.2	383.2	0.0
J	2.98	860	2,739	10.4	395.1	395.1	395.1	0.0
K	3.30	390	2,546	11.2	414.0	414.0	414.0	0.0
L	3.61	200	1,589	17.9	431.1	431.1	431.1	0.0
M	3.96	230	1,680	16.9	454.3	454.3	454.3	0.0
N	4.25	580	2,910	9.8	470.4	470.4	470.4	0.0
O	4.55	740	1,273	22.3	492.9	492.9	492.9	0.0
P	5.08	600	1,307	21.7	542.8	542.8	542.8	0.0
Q	5.28	150	1,636	17.4	564.1	564.1	564.1	0.0
R	5.52	130	1,506	18.9	580.9	580.9	580.9	0.0
S	5.78	185	1,244	22.8	609.7	609.7	609.7	0.0

[1]Miles Above Confluence With the Skagit River [2]Elevations Computed Without Consideration of Backwater Effect From the Skagit River

TABLE 4

FEDERAL EMERGENCY MANAGEMENT AGENCY

SKAGIT COUNTY, WA
(UNINCORPORATED AREAS)

FLOODWAY DATA

37

CASCADE RIVER

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Sauk River								
A	1.03	4,114	38,477	2.4	233.4	233.4	234.4	1.0
B	1.29	3,170	22,129	4.2	234.7	234.7	235.6	0.9
C	1.62	3,574	21,246	4.4	237.2	237.2	238.2	1.0
D	2.35	3,740	24,663	3.8	242.3	242.3	243.3	1.0
E	2.90	1,015	10,309	9.1	247.9	247.9	248.5	0.6
F	3.30	2,408	17,190	5.5	253.9	253.9	253.9	0.0
G	3.79	2,837	20,546	4.6	259.3	259.3	260.1	0.8
H	4.03	2,569	23,699	4.0	263.6	263.6	264.4	0.8
I	4.43	1,531	12,473	7.5	267.6	267.6	268.5	0.9
J	4.73	691	7,637	12.3	274.4	274.4	275.4	1.0
K	4.90	636	9,098	10.3	280.1	280.1	280.5	0.4
L	5.13	566	8,463	11.1	284.0	284.0	284.8	0.8
M	5.43	689	10,868	8.6	289.5	289.5	290.3	0.8
N	5.87	815	13,571	6.9	293.3	293.3	294.3	1.0
O	6.40	643	10,602	8.9	296.3	296.3	297.0	0.7
P	6.83	819	8,243	11.4	299.9	299.9	300.2	0.3
Q	7.00	320	4,801	19.6	302.2	302.2	302.4	0.2
R	7.45	376	7,747	12.1	311.6	311.6	311.6	0.0
S	7.84	415	6,537	14.4	314.4	314.4	314.4	0.0
T	8.23	380	6,153	15.3	319.1	319.1	319.1	0.0
U	8.73	420	5,979	15.7	326.6	326.6	326.6	0.0
V	9.02	646	9,845	9.6	330.1	330.1	330.1	0.0
W	9.73	1,416	11,537	8.2	335.8	335.8	336.0	0.2
X	10.35	2,549	10,254	9.3	343.9	343.9	344.4	0.5
Y	10.65	1,560	7,089	13.4	350.4	350.4	351.1	0.7
Z	11.05	2,460	13,825	6.9	359.6	359.6	359.6	0.0

[1]Miles Above Confluence With the Skagit River

TABLE 4

FEDERAL EMERGENCY MANAGEMENT AGENCY

SKAGIT COUNTY, WA
(UNINCORPORATED AREAS)

FLOODWAY DATA

SAUK RIVER

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
						(FEET NGVD)		
Sauk River (Cont'd)								
AA	11.35	2,245	10,908	8.7	362.9	362.9	363.0	0.1
AB	11.67	1,290	10,628	8.9	368.9	368.9	369.8	0.9
AC	12.01	837	8,806	10.8	373.4	373.4	374.3	0.9
AD	12.30	460	6,814	13.9	376.9	376.9	377.6	0.7
AE	12.81	702	7,236	13.1	383.5	383.5	383.7	0.2
AF	13.30	996	7,546	9.3	392.3	392.3	393.1	0.8
AG	13.66	1,498	14,906	4.7	396.3	396.3	397.1	0.8
AH	14.20	1,560	13,776	5.1	398.8	398.8	399.4	0.6
AI	14.70	1,358	10,330	6.8	402.3	402.3	402.6	0.3
AJ	15.09	1,081	8,156	8.6	406.2	406.2	406.3	0.1
AK	15.40	2,709	19,246	3.6	411.0	411.0	411.3	0.3
AL	16.14	3,382	15,221	4.6	418.6	418.6	419.0	0.4
AM	16.58	3,176	9,920	7.1	426.1	426.1	426.9	0.8

[1]Miles Above Confluence With the Skagit River

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Suiattle River								
A	0.10	2,584	25,633	2.3	391.0	391.0	391.5	0.5
B	0.32	1,636	11,960	4.9	392.7	392.7	393.2	0.5
C	0.57	1,400	7,320	8.0	400.1	400.1	400.3	0.2
D	0.77	793	6,213	9.5	409.5	409.5	409.6	0.1
E	1.04	1,140	10,289	5.7	420.7	420.7	421.6	0.9
F	1.40	793	5,064	11.6	429.8	429.8	430.1	0.3
G	1.80	581	5,633	10.4	445.5	445.5	445.6	0.1
H	2.13	1,279	7,262	8.1	456.3	456.3	456.7	0.4
I	2.49	812	6,580	8.9	466.8	466.8	467.7	0.9
J	2.76	570	4,758	12.4	479.7	479.7	479.7	0.0
K	3.08	783	5,967	9.9	490.3	490.3	490.6	0.3
L	3.47	725	6,796	8.7	502.4	502.4	503.2	0.8
M	3.80	270	3,353	17.5	511.6	511.6	511.7	0.1
N	4.19	240	3,684	16.0	525.5	525.5	526.0	0.5
O	4.53	269	3,843	15.3	533.2	533.2	533.8	0.6
P	4.68	251	3,737	15.7	539.9	539.9	540.4	0.5
Q	5.10	212	3,139	18.7	549.8	549.8	550.6	0.8
R	10.60	1,639	14,774	3.6	732.5	732.5	733.4	0.9
S	10.85	734	5,918	8.9	735.2	735.2	736.1	0.9
T	11.15	878	6,849	7.7	741.7	741.7	742.6	0.9
U	11.40	938	5,055	10.4	755.6	755.6	756.3	0.7
V	11.60	766	4,048	13.0	762.4	762.4	763.3	0.9
W	11.80	240	3,726	13.7	781.0	781.0	782.0	1.0
X	11.90	815	6,545	7.8	785.2	785.2	786.1	0.9
Y	12.15	690	3,823	13.3	791.4	791.4	791.5	0.1

[1]Miles Above Confluence With the Sauk River

TABLE 4

FEDERAL EMERGENCY MANAGEMENT AGENCY

SKAGIT COUNTY, WA
(UNINCORPORATED AREAS)

FLOODWAY DATA

SUIATTLE RIVER

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE [1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Samish River								
A	8.50	687	2,120	4.0	32.5	32.5	32.7	0.2
B	9.20	478	2,535	3.4	35.7	35.7	36.6	0.9
C	9.66	130	1,070	8.0	39.8	39.8	40.2	0.4
D	9.69	411	3,139	2.7	41.2	41.2	41.4	0.2
E	10.30	418	1,302	6.4	45.4	45.4	45.7	0.3
F	10.39	384	1,926	4.3	46.8	46.8	47.3	0.5
G	10.73	643	4,079	2.0	52.7	52.7	53.5	0.8
H	10.85	219	1,281	5.3	54.1	54.1	54.8	0.7
I	11.31	250	1,464	4.7	59.1	59.1	59.8	0.7
J	11.74	365	1,555	4.4	63.5	63.5	63.8	0.3
K	12.24	643	3,163	2.2	67.2	67.2	68.0	0.8
L	12.67	730	2,239	3.0	70.5	70.5	71.4	0.9
M	13.11	100	591	11.5	78.1	78.1	78.4	0.3
N	13.25	485	3,491	2.0	83.3	83.3	83.3	0.0
O	13.48	749	2,205	2.8	85.8	85.8	85.8	0.0
P	13.70	80	788	7.1	89.7	89.7	89.7	0.0
Q	14.10	315	1,261	4.4	92.2	92.2	93.0	0.8
R	14.51	247	1,162	4.8	99.1	99.1	99.1	0.0
S	14.89	100	651	8.6	104.9	104.9	104.9	0.0
T	15.39	87	520	10.8	118.6	118.6	118.7	0.1
U	15.83	222	1,474	3.8	127.2	127.2	127.6	0.4
V	16.20	110	536	10.5	132.9	132.9	133.0	0.1
W	16.56	565	2,033	2.8	142.7	142.7	142.7	0.0
X	17.11	240	1,074	4.5	145.8	145.8	145.9	0.1
Y	17.74	662	1,574	2.9	153.1	153.1	153.4	0.3
Z	17.82	782	1,921	2.3	153.9	153.9	154.3	0.4

[1] Miles Above Mouth at Samish Bay

TABLE 4

FEDERAL EMERGENCY MANAGEMENT AGENCY

SKAGIT COUNTY, WA
(UNINCORPORATED AREAS)

FLOODWAY DATA

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SAMISH RIVER

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Samish River (Cont'd)								
AA	18.11	454	817	5.5	157.5	157.5	158.1	0.6
AB	18.46	755	1,688	2.7	163.5	163.5	164.3	0.8
AC	18.69	759	1,353	3.3	165.2	165.2	166.0	0.8
AD	19.39	524	1,166	3.8	180.4	180.4	180.7	0.3
AE	19.86	650	1,986	2.3	186.4	186.4	186.9	0.5
AF	20.24	702	1,308	3.4	192.2	192.2	193.0	0.8
AG	20.70	360	580	7.7	203.7	203.7	204.0	0.3
AH	21.14	800	946	4.7	213.3	213.3	213.6	0.3
AI	21.47	327	758	5.9	220.6	220.6	220.8	0.2
AJ	21.80	70	469	9.6	234.1	234.1	234.1	0.0
AK	22.00	130	1,071	4.2	241.7	241.7	241.8	0.1
AL	22.41	594	3,827	1.2	242.7	242.7	242.9	0.2
AM	22.76	353	1,591	2.8	243.3	243.3	243.8	0.5
AN	23.05	126	786	5.7	245.1	245.1	245.6	0.5
AO	23.46	110	585	5.6	249.4	249.4	249.7	0.3
AP	23.76	201	1,477	2.1	251.6	251.6	251.6	0.0
AQ	23.91	188	1,192	2.5	251.7	251.7	251.7	0.0
AR	24.35	125	810	3.3	252.3	252.3	252.7	0.4
AS	24.61	193	1,187	2.2	252.7	252.7	253.5	0.8
AT	25.01	104	414	5.5	258.3	258.3	259.3	1.0
AU	25.45	108	437	4.7	263.7	263.7	264.3	0.6
AV	25.72	258	2,159	0.9	265.5	265.5	265.9	0.4
AW	26.00	130	347	5.0	266.1	266.1	266.8	0.7

[1]Miles Above Mouth at Samish Bay

TABLE 4

FEDERAL EMERGENCY MANAGEMENT AGENCY

SKAGIT COUNTY, WA
(UNINCORPORATED AREAS)

FLOODWAY DATA

SAMISH RIVER

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH[2] (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Baker River								
A	0.24	288	8,092	2.5	189.8	189.8	190.4	0.6
B	0.27	288	8,019	2.5	189.9	189.9	190.5	0.6
C	0.45	326	8,632	2.4	189.9	189.9	190.6	0.7
D	0.50	201	4,622	4.4	191.3	191.3	191.8	0.5
E	0.55	240	4,834	4.2	191.3	191.3	191.9	0.6

[1]Miles Above Confluence With the Skagit River [2]Floodway Lies Entirely Outside County Limits

flowpath is inherently more efficient than other possible alternatives, making the selection of a floodway location highly arbitrary.

Therefore, it is recommended that all communities with land use jurisdiction on the delta assume a responsibility to maintain flowpaths for floodwaters in order to minimize backwater effects which may increase future flood levels. Suggested measures include design of new roads and streets to be at grade in order that obstructive fills not be placed perpendicular to local flowpaths, preservation of swale areas and existing drainage channels, and minimization of development density in zoned agricultural areas.

As shown on the Flood Boundary and Floodway Map (Exhibit 2), the floodway boundaries were computed at cross sections. Between cross sections, the boundaries were interpolated. In cases where the floodway and 100-year floodplain boundaries are either close together or collinear, only the floodway boundary has been shown.

The area between the floodway and 100-year floodplain boundaries is termed the floodway fringe. The floodway fringe encompasses the portion of the floodplain that could be completely obstructed without increasing the water-surface elevation of the 100-year flood by more than 1.0 foot at any point. Typical relationships between the floodway and the floodway fringe and their significance to floodplain development are shown in Figure 14.

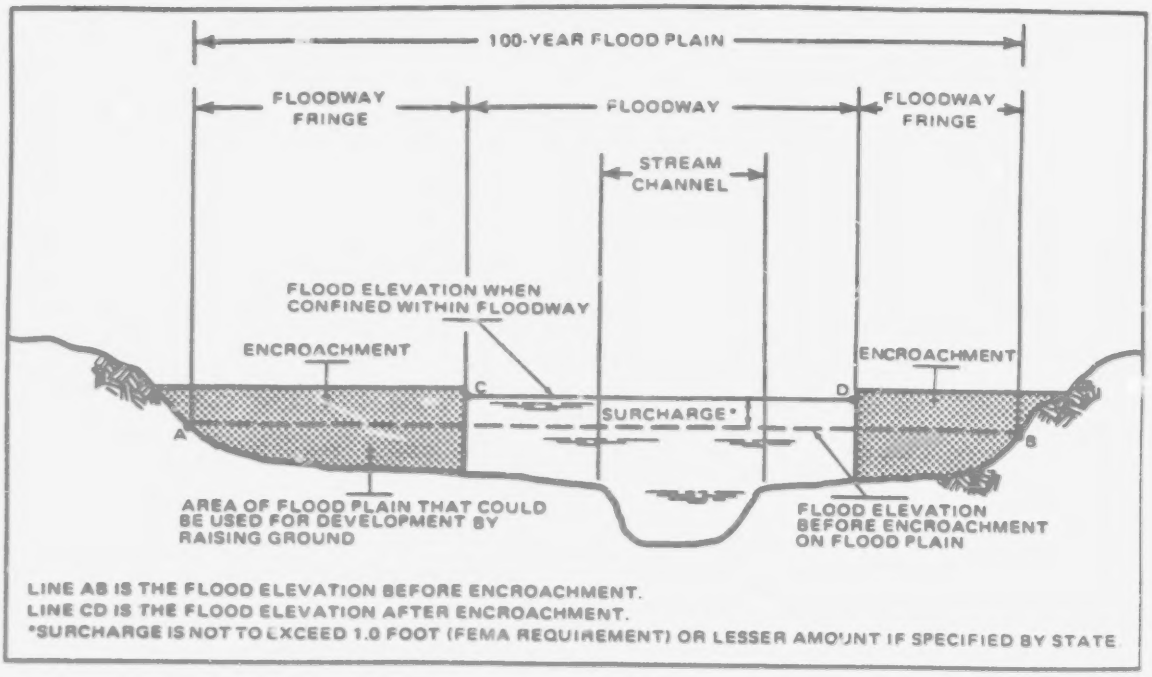
100-YEAR FLOOD PLAIN
FLOODWAY FRINGE
FLOODWAY
FLOODWAY FRINGE
STREAM CHANNEL
FLOOD ELEVATION WHEN CONFINED WITHIN FLOODWAY
ENCROACHMENT
ENCROACHMENT
C
D
SURCHARGE*
A
B
AREA OF FLOOD PLAIN THAT COULD BE USED FOR DEVELOPMENT BY RAISING GROUND
FLOOD ELEVATION BEFORE ENCROACHMENT ON FLOOD PLAIN
LINE AB IS THE FLOOD ELEVATION BEFORE ENCROACHMENT.
LINE CD IS THE FLOOD ELEVATION AFTER ENCROACHMENT.
*SURCHARGE IS NOT TO EXCEED 1.0 FOOT (FEMA REQUIREMENT) OR LESSER AMOUNT IF SPECIFIED BY STATE

Figure 14. Floodway Schematic

5.0 INSURANCE APPLICATION

To establish actuarial insurance rates, data from the engineering study must be transformed into flood insurance criteria. This process includes the determination of reaches, Flood Hazard Factors (FHFs), and flood insurance zone designations for each flooding source studied in detail affecting Skagit County, Washington.

5.1 Reach Determinations

Reaches are defined as sections of floodplain that have relatively the same flood hazard, based on the average weighted difference in water-surface elevations between the 10- and 100-year floods. This difference may not have a variation greater than that indicated in the following table for more than 20 percent of the reach:

Average Difference Between 10- and 100-Year Floods	Variation
Less than 2 feet	0.5 foot
2 to 7 feet	1.0 foot
7.1 to 12 feet	2.0 feet
More than 12 feet	3.0 feet

The COE has estimated that the 10-year discharge of the Skagit River in the delta area would be contained in the channel; therefore, the FHFs for the overland flows were determined by the average difference between the ground elevations and the 100-year flood elevations.

The locations of the reaches determined for the flooding sources of Skagit County are shown on the Flood Profiles (Exhibit 1) and summarized in Table 5.

5.2 Flood Hazard Factors

The FHF is used to establish relationships between depth and frequency of flooding in any reach. This relationship is then used with depth-damage relationships for various classes of structures to establish actuarial insurance rate tables.

The FHF for a reach is the average weighted difference between the 10- and 100-year flood water-surface elevations rounded to the nearest one-half foot, multiplied by 10, and shown as a three-digit code. For example, if the difference between water-surface elevations of the 10- and 100-year floods is 0.7 foot, the FHF is 005; if the difference is 1.4 feet, the FHF is 015; if the difference is 5.0 feet, the FHF is 050. When the difference between the 10-and 100-year flood water-surface elevations is greater than 10.0 feet, it is rounded to the nearest whole foot.

FLOODING SOURCE	PANEL[1]	ELEVATION DIFFERENCE[2] BETWEEN 1% (100-YEAR) FLOOD AND			FLOOD HAZARD FACTOR	ZONE	BASE FLOOD ELEVATION (FEET NGVD)[3]
		10% (10-YEAR)	2% (50-YEAR)	0.2% (500-YEAR)			
Skagit River Delta Overbank Flow Path 1 Reach 1	0235,0250 0255,0275	-3.73[4]	N/A	N/A	035	A7	Varies - See Map
Skagit River Delta Overbank Flow Path 2 Reach 1	0045,0050 0235,0250	-3.88[4]	N/A	N/A	040	A8	Varies - See Map
Skagit River Delta Overbank Flow Path 3 Reach 3	0250,0425	-3.46[4]	N/A	N/A	035	A7	Varies - See Map
North Fork Skagit River							
Reach 1	0425	N/A	N/A	N/A	005	A1	Varies - See Map
Shallow Flooding Sheet Flow							
Reach 1	0425	N/A	N/A	N/A	N/A	A0	Depth 1, Velocity 5
Reach 2	0425	N/A	N/A	N/A	N/A	A0	Depth 3, Vel. 14
Reach 3	0425	N/A	N/A	N/A	N/A	A0	Depth 3, Velocity 9
South Fork Skagit River							
Reach 1	0425	N/A	N/A	N/A	005	A1	Varies - See Map
Shallow Flooding Sheet Flow							
Reach 1	0425	N/A	N/A	N/A	N/A	A0	Depth 1, Velocity 7
Reach 2	0425	N/A	N/A	N/A	N/A	A0	Depth 1, Velocity 4

[1]Flood Insurance Rate Map Panel [2]Weighted Average [3]Rounded to Nearest Foot

[4]Elevation Difference Between 100-Year Elevation and Average Ground Elevation

TABLE 5

FEDERAL EMERGENCY MANAGEMENT AGENCY

SKAGIT COUNTY, WA
(UNINCORPORATED AREAS)

FLOOD INSURANCE ZONE DATA

SKAGIT RIVER DELTA OVERBANK FLOW PATH 1-SKAGIT RIVER DELTA OVERBANK FLOW PATH 2-SKAGIT RIVER DELTA OVERBANK FLOW PATH 3-NORTH FORK SKAGIT RIVER-SOUTH FORK SKAGIT RIVER

FLOODING SOURCE	PANEL[1]	ELEVATION DIFFERENCE[2] BETWEEN 1% (100-YEAR) FLOOD AND			FLOOD HAZARD FACTOR	ZONE	BASE FLOOD ELEVATION (FEET NGVD)[3]
		10% (10-YEAR)	2% (50-YEAR)	0.2% (500-YEAR)			
Main Stem Skagit River							
Reach 1	0250,0425	N/A	N/A	N/A	005	A1	Varies - See Map
Deep Ponding	0250	N/A	N/A	N/A	110	A21	30
Ponding	0250,0425	N/A	N/A	N/A	N/A	AH	15
Shallow Flooding Sheet Flow	0250,0425	N/A	N/A	N/A	N/A	A0	Depth 1
	0250,0425	N/A	N/A	N/A	N/A	A0	Depth 2
	0425	N/A	N/A	N/A	N/A	A0	Depth 3
Reach 1	0425	N/A	N/A	N/A	N/A	A0	Depth 3, Velocity 9
Reach 2	0250	N/A	N/A	N/A	N/A	A0	Depth 3, Velocity 6
Reach 3	0250,0425	N/A	N/A	N/A	N/A	A0	Depth 3, Velocity 5
Reach 4	0250	N/A	N/A	N/A	N/A	A0	Depth 3, Velocity 6
Reach 5	0250	N/A	N/A	N/A	N/A	A0	Depth 3, Velocity 5
Reach 6	0250	N/A	N/A	N/A	N/A	A0	Depth 3, Velocity 4
Skagit River							
Reach 1	0255,0260	-4.81	-1.59	3.31	050	A10	Varies - See Map
Reach 2	0255,0260	-3.22	-0.91	2.49	030	A6	Varies - See Map
Reach 3	0260,0280 0285	-6.16	-1.90	4.41	060	A12	Varies - See Map
Reach 4	0285	-10.69	-3.51	8.36	110	A21	Varies - See Map
Reach 5	0285,0305	-12.04	-3.80	7.72	120	A22	Varies - See Map
Reach 6	0285,0305	-7.88	-2.58	5.87	080	A16	Varies - See Map
Reach 7	0140,0305 0330	-4.32	-1.99	6.00	045	A9	Varies - See Map

[1]Flood Insurance Rate Map Panel [2]Weighted Average [3]Rounded to Nearest Foot

TABLE 5

FEDERAL EMERGENCY MANAGEMENT AGENCY

SKAGIT COUNTY, WA
(UNINCORPORATED AREAS)

FLOOD INSURANCE ZONE DATA

MAIN STEM SKAGIT RIVER-SKAGIT RIVER

FLOODING SOURCE	PANEL[1]	ELEVATION DIFFERENCE[2] BETWEEN 1% (100-YEAR) FLOOD AND			FLOOD HAZARD FACTOR	ZONE	BASE FLOOD ELEVATION (FEET NGVD)[3]
		10% (10-YEAR)	2% (50-YEAR)	0.2% (500-YEAR)			
Skagit River Split Flow							
Reach 1	0140,0330	-0.91[4]	N/A	4.02	010	A2	Varies - See Map
Cascade River							
Reach 1	0330	-3.22	-1.06	1.60	030	A6	Varies - See Map
Reach 2	0330	-5.88	-3.15	3.75	060	A12	Varies - See Map
Sauk River							
Reach 1	0315,0320	-2.90	-0.96	2.34	030	A6	Varies - See Map
Reach 2	0320,0485	-4.78	-1.32	3.14	050	A10	Varies - See Map
Reach 3	0485	-7.02	-2.16	5.01	070	A14	Varies - See Map
Reach 4	0485	-5.19	-1.53	3.90	050	A10	Varies - See Map
Reach 5	0485,0495	-3.36	-1.18	2.37	035	A7	Varies - See Map
Suiattle River							
Reach 1	0485,0495	-3.78	-1.06	2.45	040	A8	Varies - See Map
Reach 2	0485	-5.09	-1.52	3.83	050	A10	Varies - See Map
Reach 3	0515	-3.73	-1.17	2.89	035	A7	Varies - See Map
Samish River							
Reach 1	0045,0235	-1.44	-0.35	1.85	015	A3	Varies - See Map
Reach 2	0045,0065	-2.34	-0.78	1.68	025	A5	Varies - See Map
Reach 3	0045,0065	-1.07	-0.28	0.92	010	A2	Varies - See Map
Reach 4	0055,0065	-2.21	-0.57	1.36	020	A4	Varies - See Map

[1]Flood Insurance Rate Map Panel [2]Weighted Average [3]Rounded to Nearest Foot

[4]Elevation Difference Between 100-Year Elevation and Average Ground Elevation

TABLE 5

FEDERAL EMERGENCY MANAGEMENT AGENCY

SKAGIT COUNTY, WA
(UNINCORPORATED AREAS)

FLOOD INSURANCE ZONE DATA

SKAGIT RIVER SPLIT FLOW-CASCADE RIVER-SAUK RIVER-SUIATTLE RIVER-SAMISH RIVER

FLOODING SOURCE	PANEL[1]	ELEVATION DIFFERENCE[2] BETWEEN 1% (100-YEAR) FLOOD AND			FLOOD HAZARD FACTOR	ZONE	BASE FLOOD ELEVATION (FEET NGVD)[3]
		10% (10-YEAR)	2% (50-YEAR)	0.2% (500-YEAR)			
Baker River							
Reach 1	0285	-9.0	-3.0	7.1	090	A18	Varies - See Map
Skagit Bay							
Southern Corporate Limits to South of Boom Slough	0425	N/A	N/A	N/A	005	V1	11
Boom Slough to Goat Island	0225,0425	-2.1	N/A	N/A	020	V4	10
North of Goat Island Between Dot Island and Swinomish Slough	0225,0425	-0.6	N/A	N/A	005	A1	8
Northwest of Goat Island to Hope Island	0225	-2.0	N/A	N/A	020	A4	10
Hope Island to Skagit Island	0225	-0.5	N/A	N/A	005	A1	8
Swinomish Channel From La Conner to Padilla Bay	0250,0425	-0.6	N/A	N/A	005	A1	8

[1]Flood Insurance Rate Map Panel [2]Weighted Average [3]Rounded to Nearest Foot

TABLE 5

FEDERAL EMERGENCY MANAGEMENT AGENCY

SKAGIT COUNTY, WA
(UNINCORPORATED AREAS)

FLOOD INSURANCE ZONE DATA

BAKER RIVER-SKAGIT BAY-SWINOMISH CHANNEL

FLOODING SOURCE	PANEL[1]	ELEVATION DIFFERENCE[2] BETWEEN 1% (100-YEAR) FLOOD AND			FLOOD HAZARD FACTOR	ZONE	BASE FLOOD ELEVATION (FEET NGVD)[3]
		10% (10-YEAR)	2% (50-YEAR)	0.2% (500-YEAR)			
Similk Bay							
Similk Bay and Deception Pass West to State Highway 20	0225	-0.4	N/A	N/A	005	A1	8
Rosario Strait							
Deception Pass West of State Highway 20 to Langley Point	0225	-2.0	N/A	N/A	020	V4	8
Langley Point to Northern County Limits	0025,0225	-2.0	N/A	N/A	020	V4	9
Burrows Bay							
Langley Bay to Alexander Beach	0225	-2.0	N/A	N/A	020	V4	9
Alexander Beach to Burrows Pass	0225	-0.5	N/A	N/A	005	A1	7
Bellingham Channel							
Guemes Channel to Southern Sinclair Island	0025,0225	-2.0	N/A	N/A	020	A4	9
Towhead Island to Eagle Harbor	0025	-0.5	N/A	N/A	005	A1	7

[1]Flood Insurance Rate Map Panel [2]Weighted Average [3]Rounded to Nearest Foot

TABLE 5

FEDERAL EMERGENCY MANAGEMENT AGENCY

SKAGIT COUNTY, WA
(UNINCORPORATED AREAS)

FLOOD INSURANCE ZONE DATA

SIMILK BAY-ROSARIO STRAIT-BURROWS BAY-BELLINGHAM CHANNEL

FLOODING SOURCE	PANEL[1]	ELEVATION DIFFERENCE[2] BETWEEN 1% (100-YEAR) FLOOD AND			FLOOD HAZARD FACTOR	ZONE	BASE FLOOD ELEVATION (FEET NGVD)[3]
		10% (10-YEAR)	2% (50-YEAR)	0.2% (500-YEAR)			
Samish and Padilla Bays	0025,0050 0225,0250	-2.0	N/A	N/A	020	A4,V4	9
Fidalgo Bay	0225	-0.6	N/A	N/A	005	A1	7

[1]Flood Insurance Rate Map Panel [2]Weighted Average [3]Rounded to Nearest Foot

TABLE 5

FEDERAL EMERGENCY MANAGEMENT AGENCY

SKAGIT COUNTY, WA
(UNINCORPORATED AREAS)

FLOOD INSURANCE ZONE DATA

SAMISH AND PADILLA BAYS-FIDALGO BAY

5.3 Flood Insurance Zones

Flood insurance zones and zone numbers are assigned based on the type of flood hazard and the FHF, respectively. A unique zone number is associated with each possible FHF, and varies from 1 for a FHF of 005 to a maximum of 30 for a FHF of 200 or greater.

Zone A:	Special Flood Hazard Areas inundated by the 100-year flood, determined by approximate methods; no base flood elevations shown or FHFs determined.
Zones A1-10, A12, A14, A16, A18, A21, and A22:	Special Flood Hazard Areas inundated by the 100-year flood; with base flood elevations shown, and zones subdivided according to FHFs.
Zones V1 and V4:	Special Flood Hazard Areas along coasts inundated by the 100-year flood; with base flood elevations shown, and zones subdivided according to FHFs.
Zone AO:	Special Flood Hazard Areas inundated by types of 100-year shallow flooding where depths are between 1.0 and 3.0 feet; depths are shown, but no FHFs are determined.
Zone AH:	Special Flood Hazard Areas inundated by types of 100-year shallow flooding where depths are between 1.0 and 3.0 feet; base flood elevations are shown, but no FHFs are determined.
Zone B:	Areas between the Special Flood Hazard Areas and the limits of the 500-year flood; areas that are protected from the 100- or 500-year floods by dike, levee, or other local water-control structure; areas subject to certain types of 100-year shallow flooding where depths are less than 1.0 foot; and areas subject to 100-year flooding from sources with drainage areas less than 1 square mile. Zone B is not subdivided.
Zone C:	Areas of minimal flood hazard; not subdivided.

The flood elevation differences, FHFs, flood insurance zones, and base flood elevations for each flooding source studied in detail in the community are summarized in Table 5.

5.4 Flood Insurance Rate Map Description

The Flood Insurance Rate Map for Skagit County is, for insurance purposes, the principal product of the Flood Insurance Study. This map contains the official delineation of flood insurance zones and base flood elevations. Base flood elevation lines show the locations of the expected whole-foot water-surface elevation of the base (100-year) flood. The base flood elevations and zone numbers are used by insurance agents, in conjunction with structure elevations and characteristics, to assign actuarial insurance rates to structures and contents insured under the NFIP.

6.0 OTHER STUDIES

In June 1972, the COE, Seattle District, under contract to the Federal Insurance Administration, completed a Flood Insurance Study for the unincorporated areas of Skagit County, Washington (Reference 30). This study was not formally released by FEMA, but limited distribution was made to State and local officials for interim use in floodplain management. This study supersedes the 1972 Flood Insurance Study.

The COE, Seattle District, has published several reports and studies on the Skagit River Basin, including: Flood Control and Other Improvements, March 1965; Flood Plain Information Studies, July 1966 and April 1967; Sauk River Suggested Hydraulic Floodway, June 1976; Authorization for Additional Flood Control at Upper Baker Project, June 1976; and Skagit River, Washington, General Design Memorandum for Levee Improvements, July 1979 (References 31-35 and 9). These studies are in agreement with or are superseded by this study.

Additional studies of the Skagit River Basin include the Puget Sound and Adjacent Waters study by the Puget Sound Task Force of the Pacific Northwest River Basins Commission in 1970 and a Comprehensive Land Use Planning Alternatives for the Skagit River Floodplain and Related Uplands report by the Skagit Regional Planning Council in April 1973 (References 7 and 36).

On November 10, 1978, under Public Law 95-625, portions of the Skagit River and its tributaries, the Cascade, Suiattle, and Sauk Rivers, were incorporated into the National Wild and Scenic River System. Studies are underway by the U.S. Forest Service to detail boundaries of the river areas and prepare a management plan to protect and enhance those scenic, scientific, geologic, historic, cultural, recreational, and fish and wildlife values for which the river was designated as a component of the National Wild and Scenic River System.

Flood Insurance Studies have been prepared for the Towns of Concrete, Hamilton, and Lyman; the City of Sedro Woolley; and for the unincorporated areas of Chelan, Island, Okanogan, and Whatcom Counties (References 37-44). These studies are in agreement with this study.

Flood Insurance Studies are being prepared for the City of Burlington, the Town of La Conner, the City of Mount Vernon, and the unincorporated areas of Snohomish County (References 45-48). These studies will agree with this Flood Insurance Study.

Flood Hazard Boundary Maps for the unincorporated areas of San Juan and Skagit Counties are superseded by this Flood Insurance Study (References 49 and 23).

This study is authoritative for the purposes of the NFIP; data presented herein either supersede or are compatible with all previous determinations.

7.0 LOCATION OF DATA

Information concerning the pertinent data used in the preparation of this study can be obtained by contacting the Natural and Technological Hazards Division, FEMA, Federal Regional Center, 130 228th Street, SW., Bothell, Washington 98011.

8.0 BIBLIOGRAPHY AND REFERENCES

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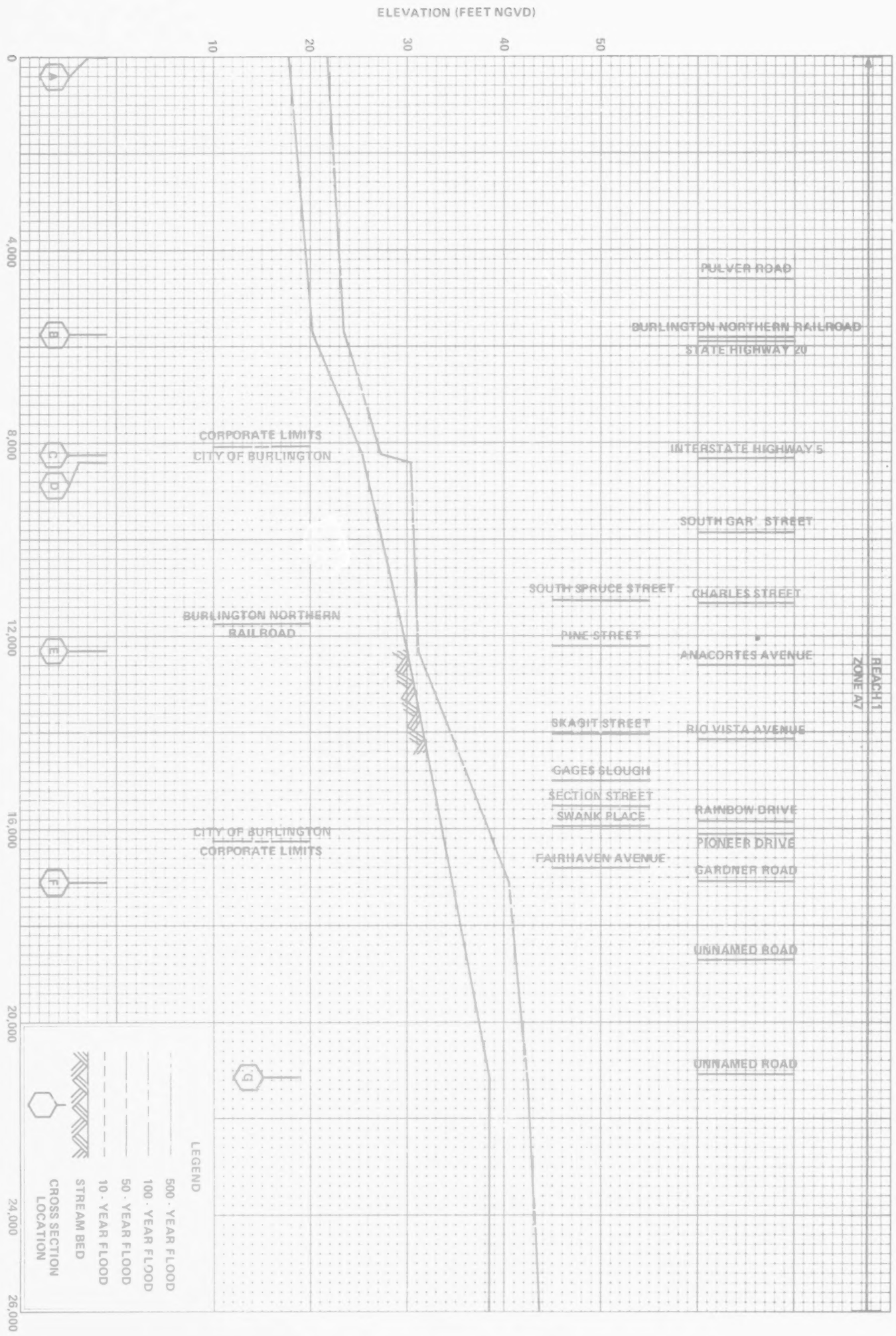
9.0 REVISIONS DESCRIPTION

This section has been added to provide information regarding significant revisions made since the original Flood Insurance Study was printed. Future revisions may be made that do not result in the republishing of the Flood Insurance Study report. To ensure that any user is aware of all revisions, please contact the community repository of flood hazard data located at the Skagit County Permit Center, County Administration Building, Mt. Vernon, Washington 98273.

9.1 First Revision

This study was revised on September 29, 1989, to resolve discrepancies in Special Flood Hazard Areas and zone designations between Skagit County, Washington and the City of Sedro Woolley, Washington. Based on topographic data, the Special Flood Hazard Areas in Skagit County, located adjacent to the southwest corner of Sedro Woolley, were revised to reflect a Zone C flood designation. This designation is assigned to areas of minimal flooding.

This revision is reflected on Flood Insurance Rate Map Panels 0255 and 0235 for Skagit County. The effective Flood Boundary and Floodway Map for Skagit County was not affected by this revision.



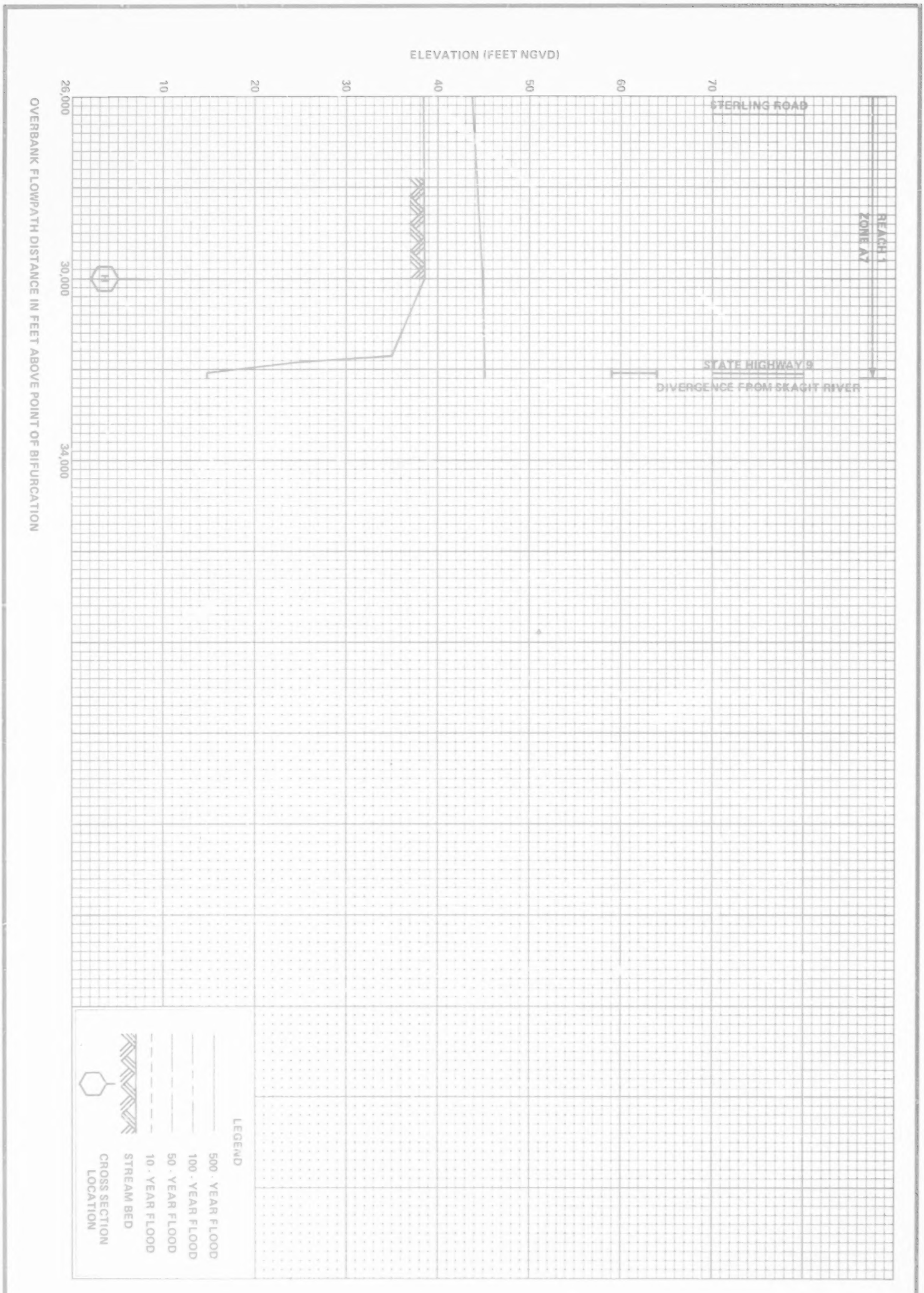
01P

FEDERAL EMERGENCY MANAGEMENT AGENCY

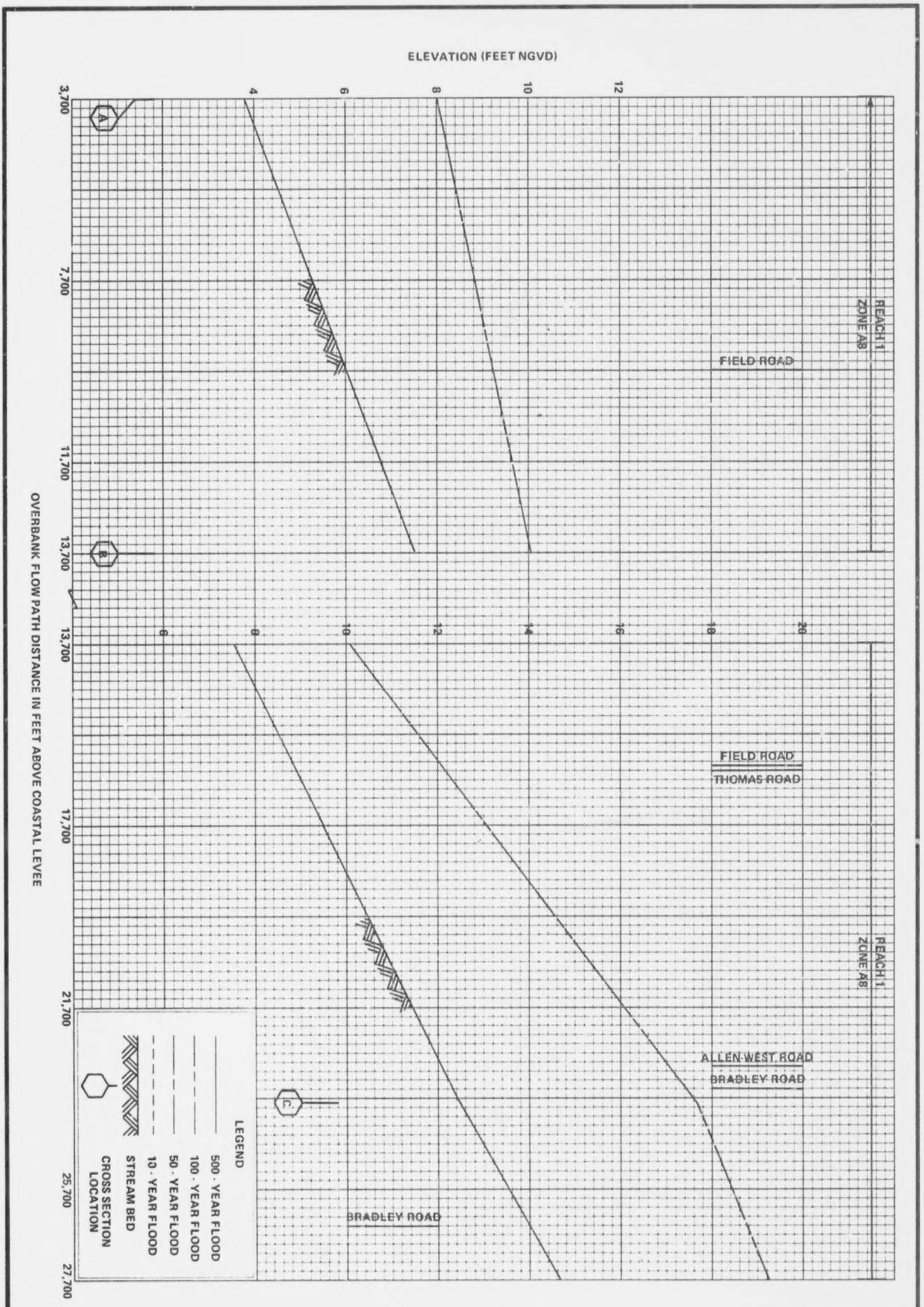
SKAGIT COUNTY, WA
(UNINCORPORATED AREAS)

FLOOD PROFILES

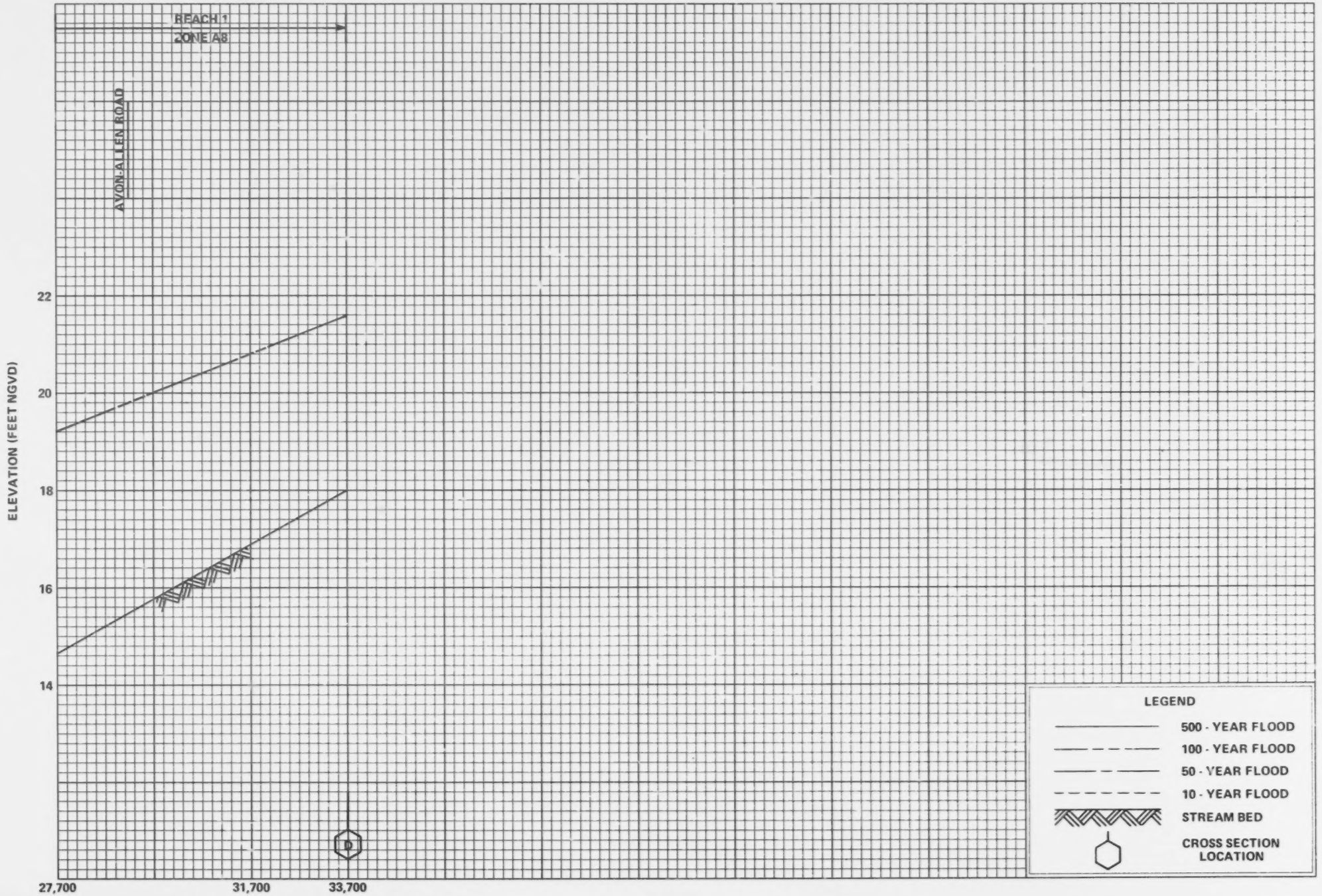
SKAGIT RIVER DELTA, OVERBANK FLOWPATH 1



02P	FEDERAL EMERGENCY MANAGEMENT AGENCY SKAGIT COUNTY, WA (UNINCORPORATED AREAS)	FLOOD PROFILES SKAGIT RIVER DELTA, OVERBANK FLOWPATH 1



03P	FEDERAL EMERGENCY MANAGEMENT AGENCY SKAGIT COUNTY, WA (UNINCORPORATED AREAS)	FLOOD PROFILES SKAGIT RIVER DELTA, OVERBANK FLOWPATH 2



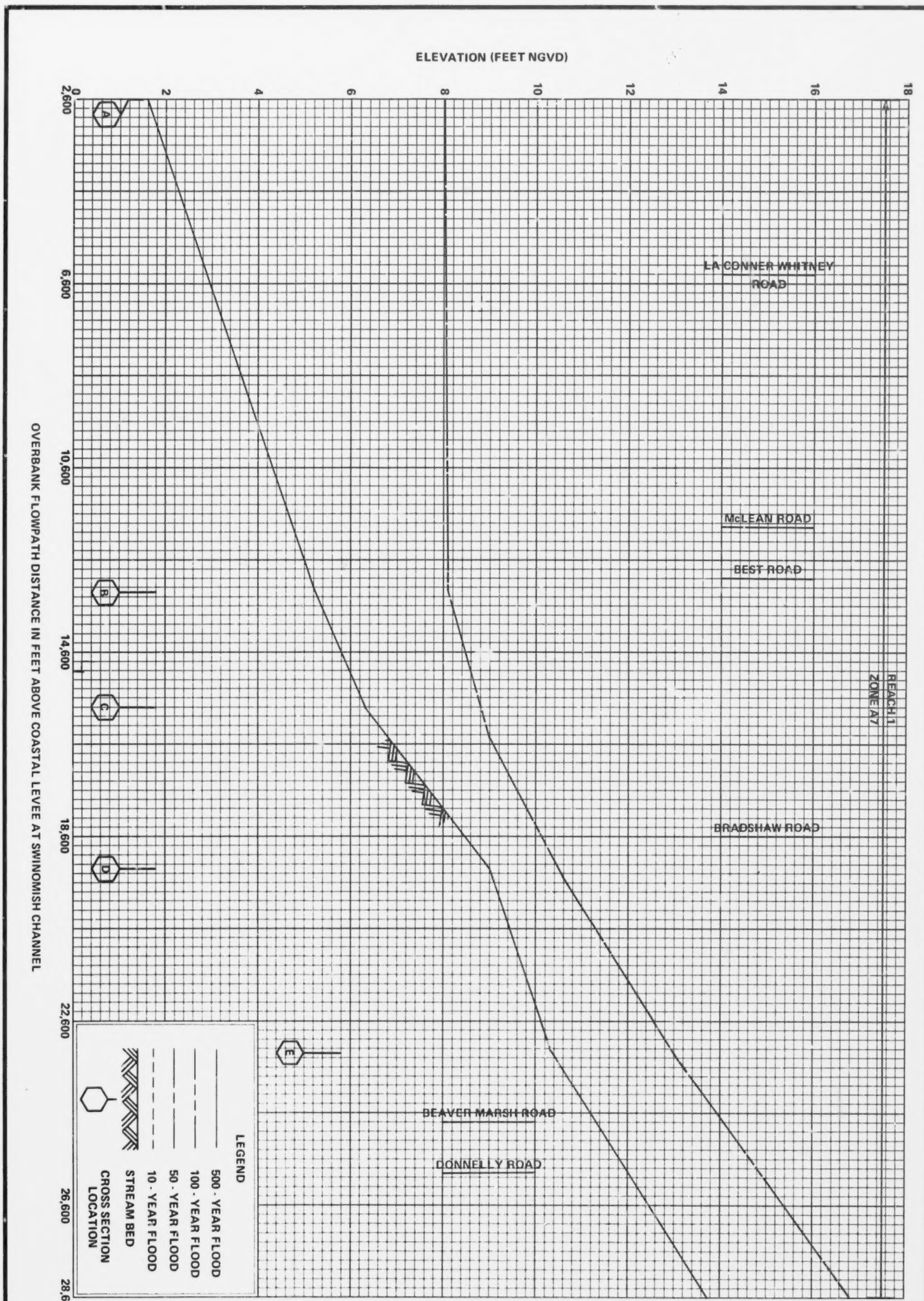
FLOOD PROFILES

SKAGIT RIVER DELTA, OVERBANK FLOWPATH 2

FEDERAL EMERGENCY MANAGEMENT AGENCY

SKAGIT COUNTY, WA
(UNINCORPORATED AREAS)

04P



63

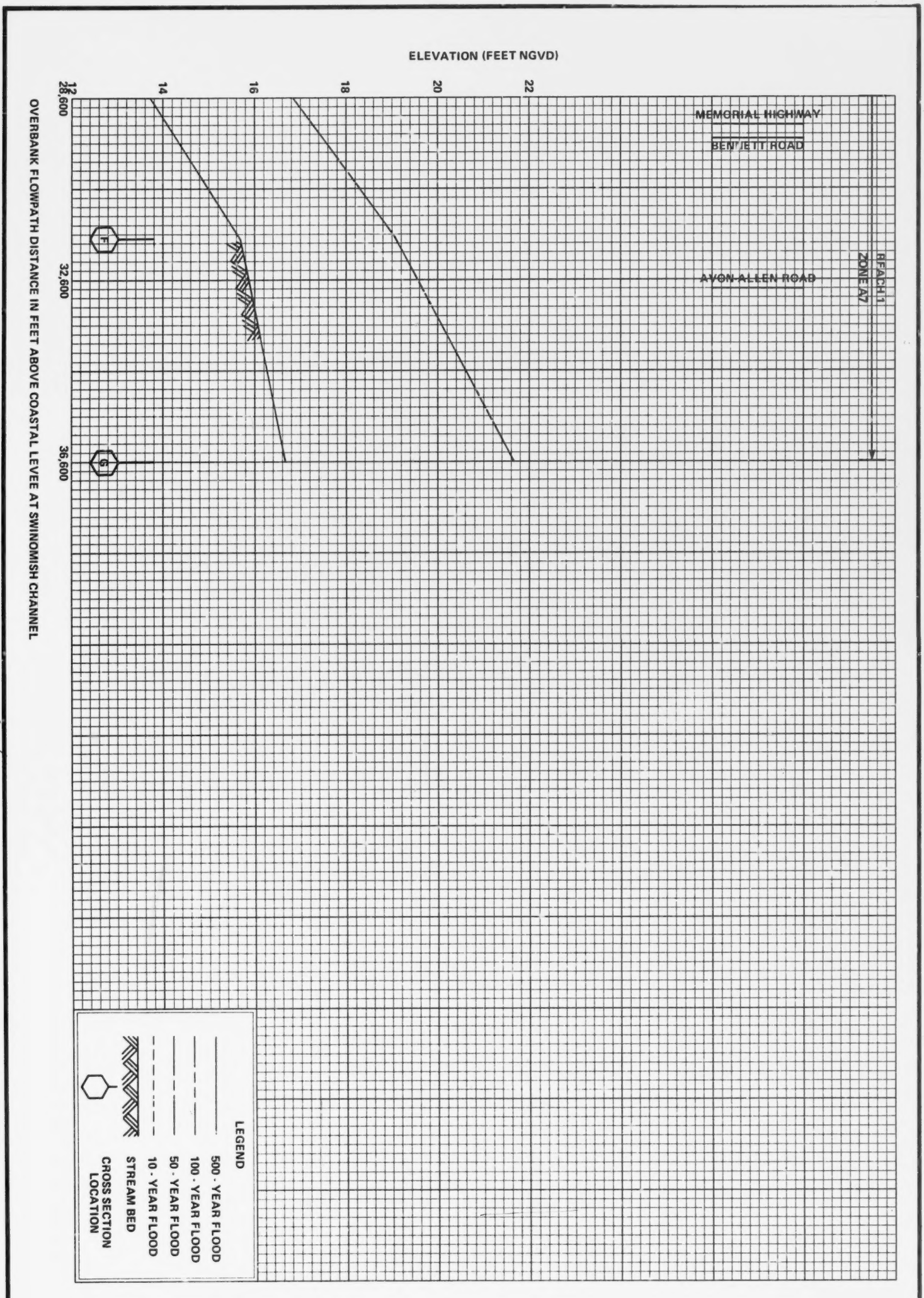
05P

FEDERAL EMERGENCY MANAGEMENT AGENCY

SKAGIT COUNTY, WA
(UNINCORPORATED AREAS)

FLOOD PROFILES

SKAGIT RIVER DELTA, OVERBANK FLOWPATH 3



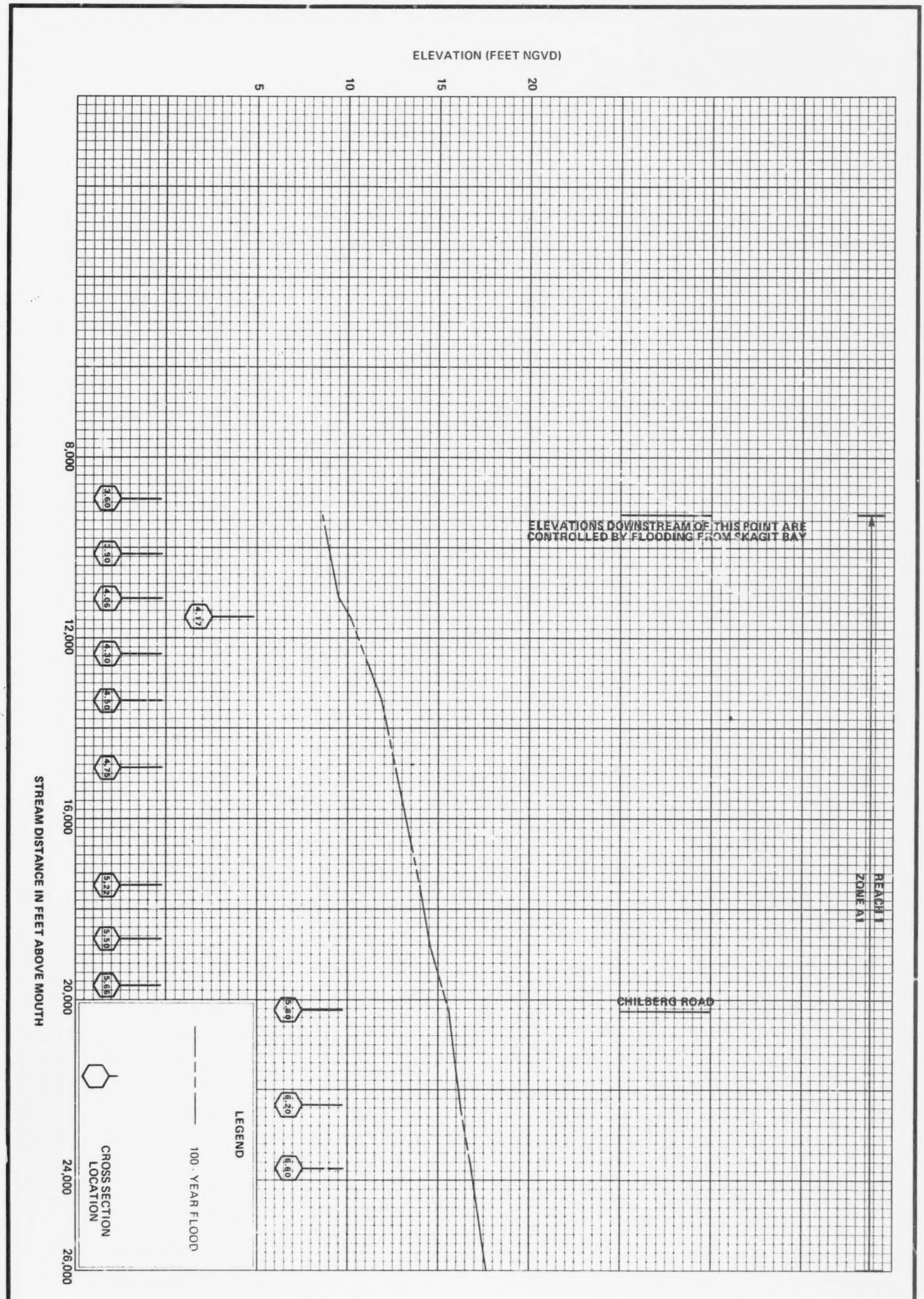
OGP

FEDERAL EMERGENCY MANAGEMENT AGENCY

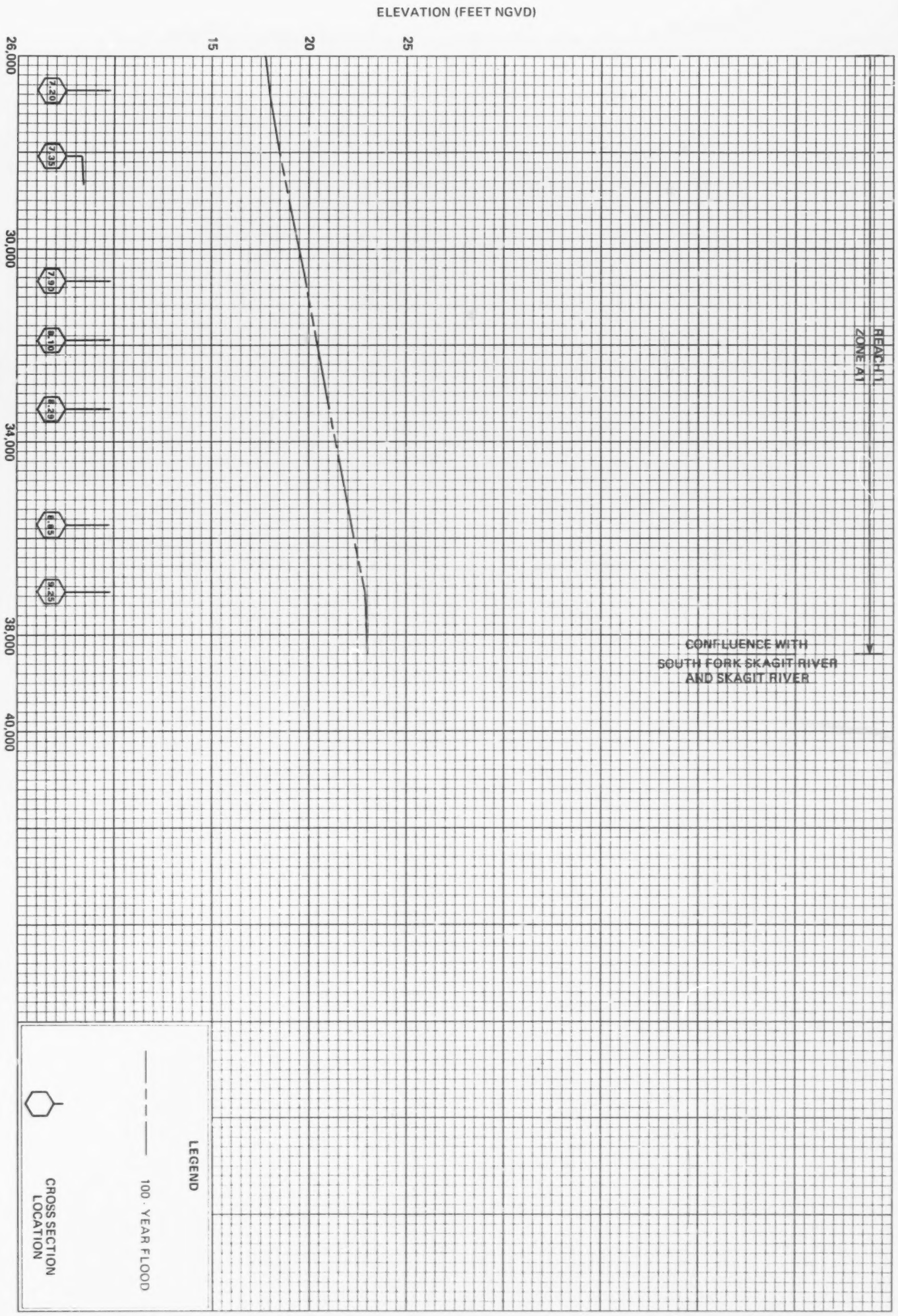
SKAGIT COUNTY, WA
(UNINCORPORATED AREAS)

FLOOD PROFILES

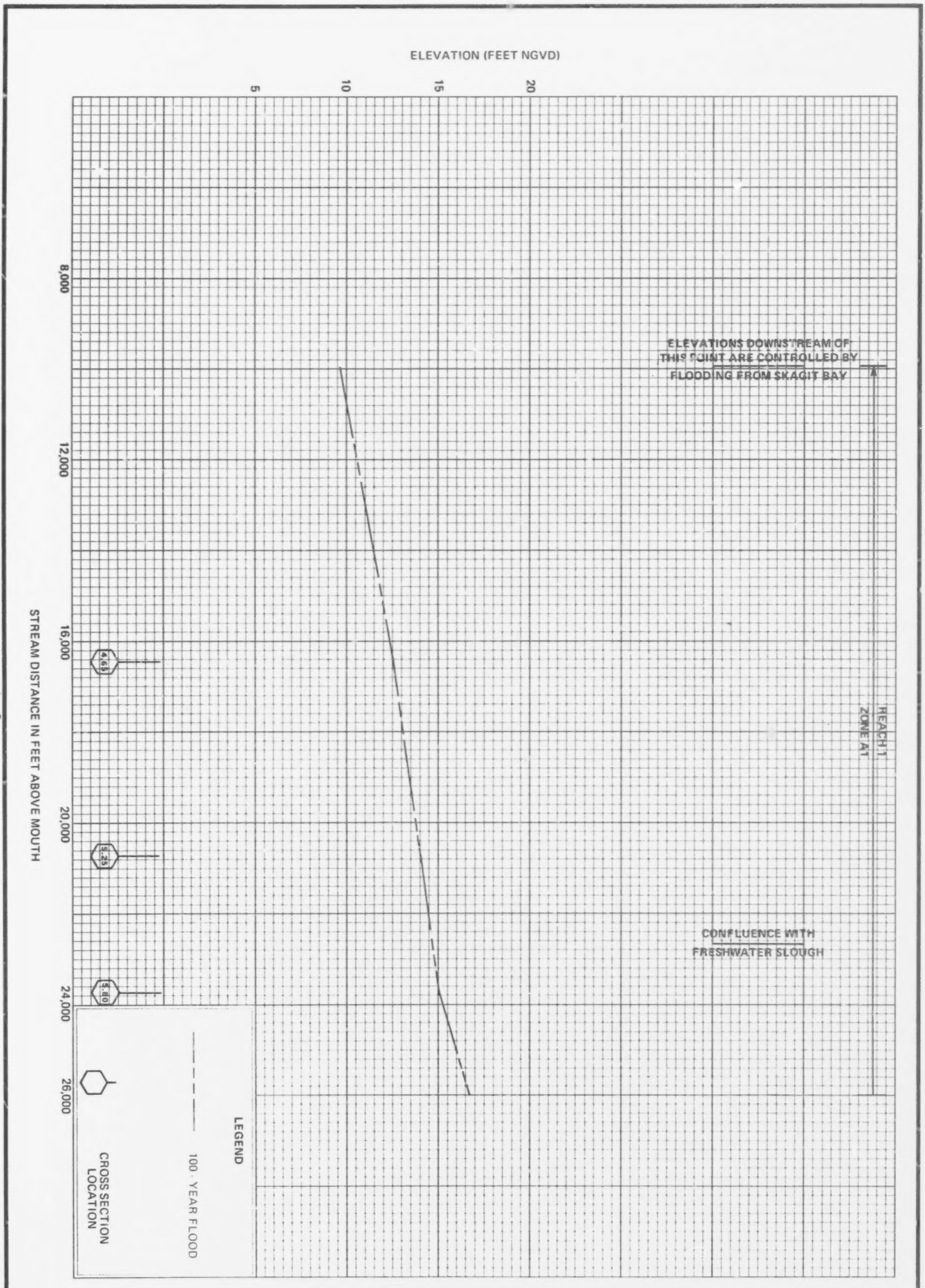
SKAGIT RIVER DELTA, OVERBANK FLOWPATH 3



07P	FEDERAL EMERGENCY MANAGEMENT AGENCY SKAGIT COUNTY, WA (UNINCORPORATED AREAS)	FLOOD PROFILES NORTH FORK SKAGIT RIVER



08P	FEDERAL EMERGENCY MANAGEMENT AGENCY SKAGIT COUNTY, WA (UNINCORPORATED AREAS)	FLOOD PROFILES NORTH FORK SKAGIT RIVER



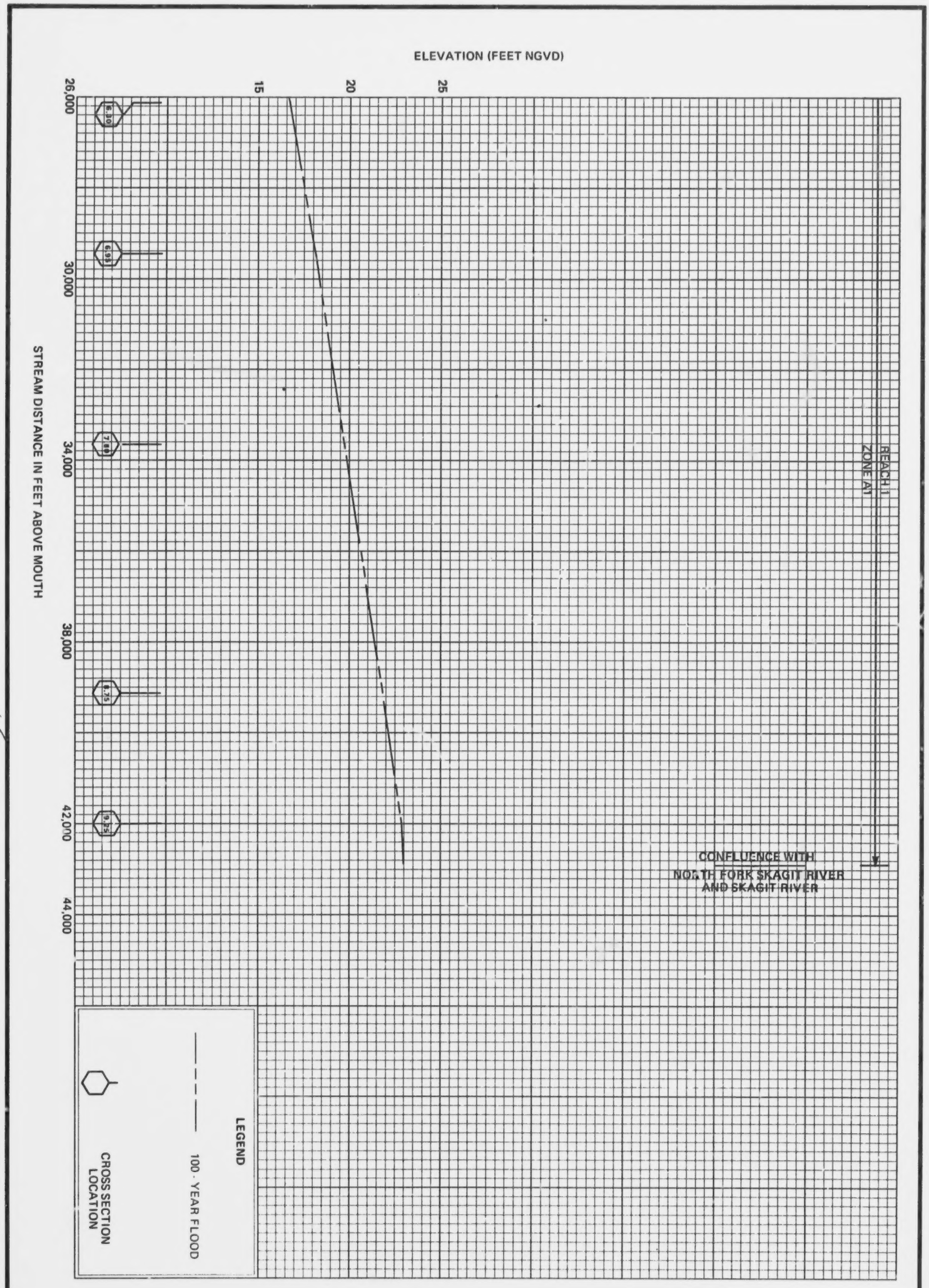
09P

FEDERAL EMERGENCY MANAGEMENT AGENCY

SKAGIT COUNTY, WA
(UNINCORPORATED AREAS)

FLOOD PROFILES

SOUTH FORK SKAGIT RIVER



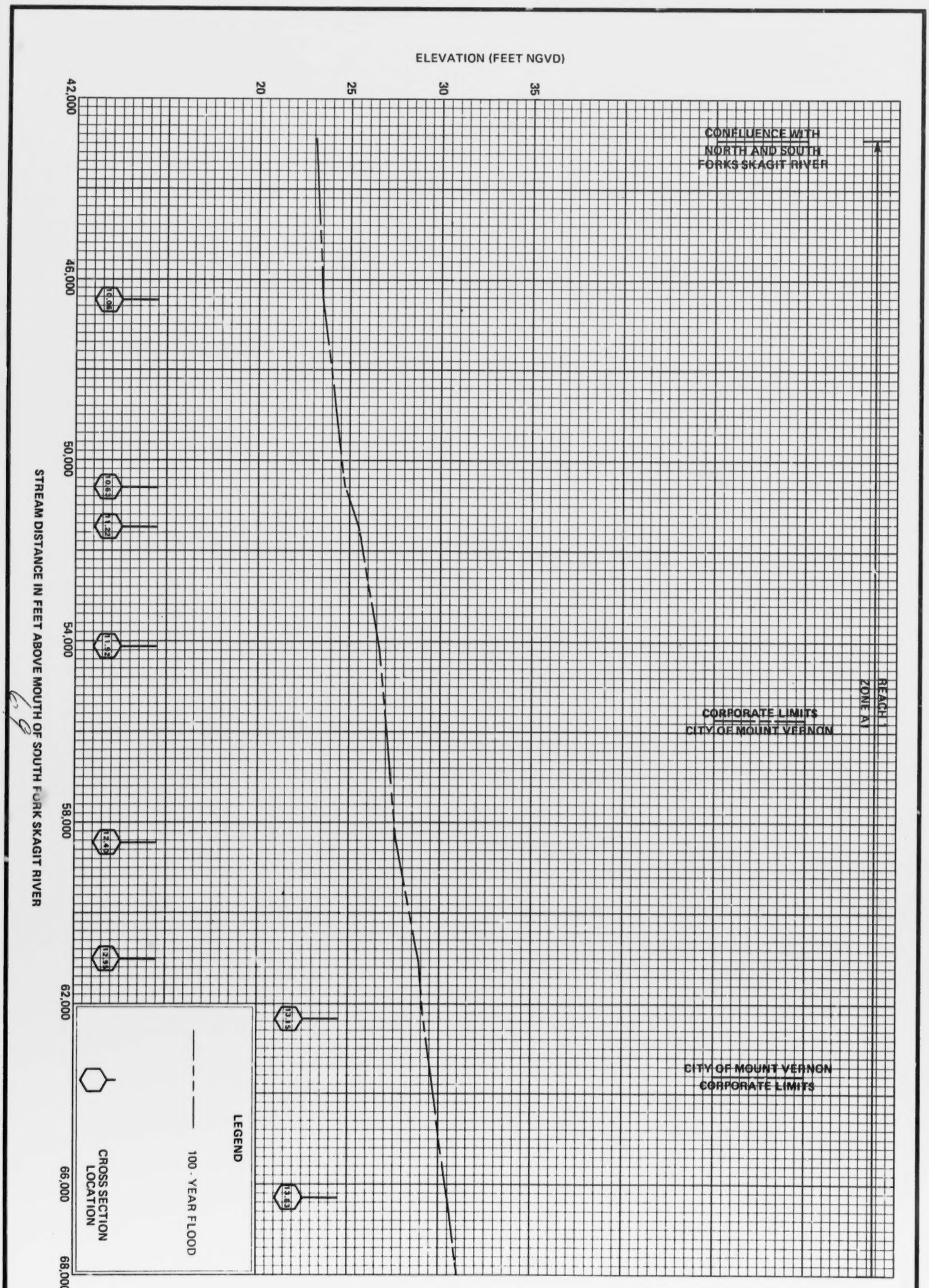
10P

FEDERAL EMERGENCY MANAGEMENT AGENCY

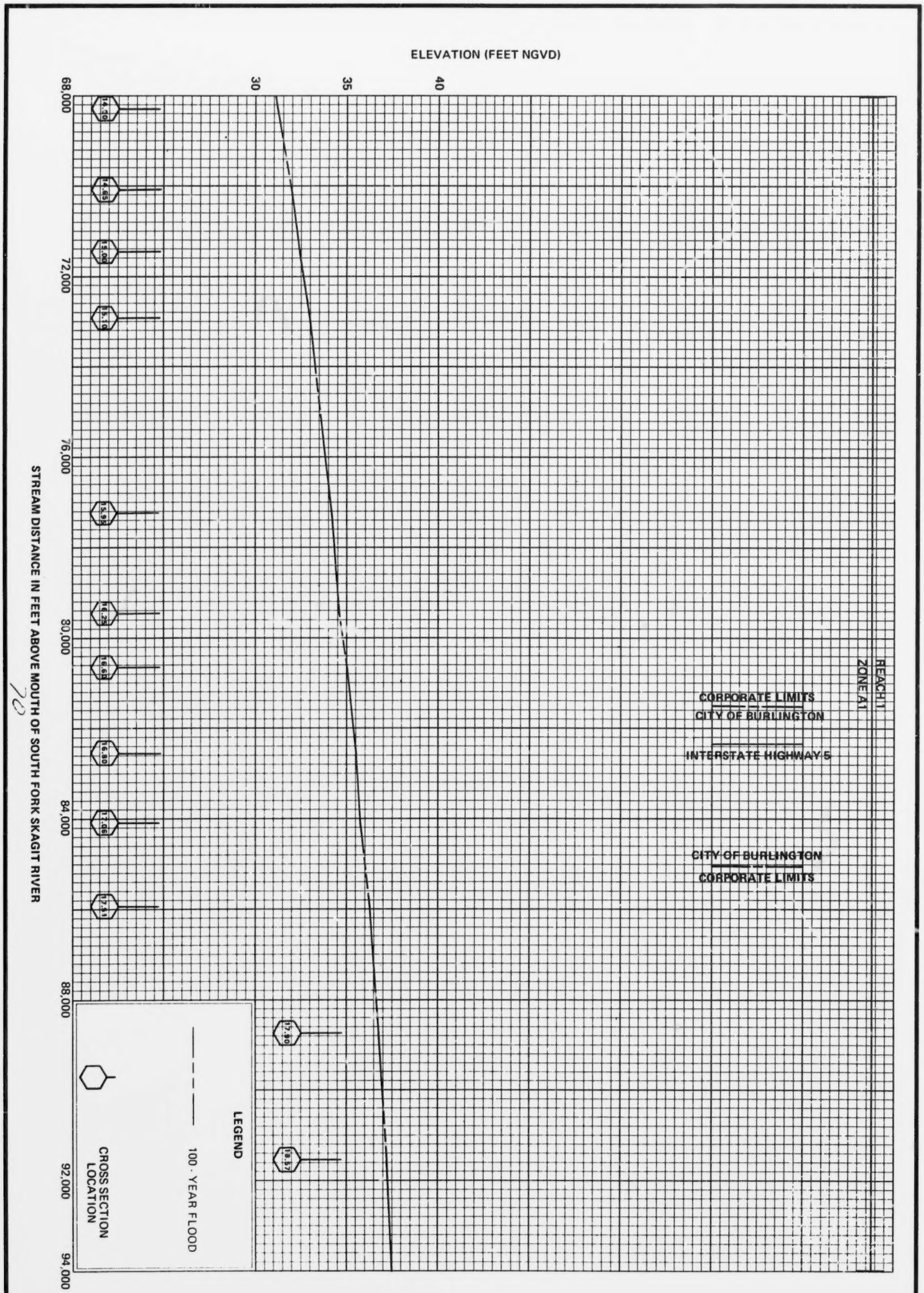
SKAGIT COUNTY, WA
(UNINCORPORATED AREAS)

FLOOD PROFILES

SOUTH FORK SKAGIT RIVER



11P	FEDERAL EMERGENCY MANAGEMENT AGENCY SKAGIT COUNTY, WA (UNINCORPORATED AREAS)	FLOOD PROFILES MAIN STEM SKAGIT RIVER



12P	FEDERAL EMERGENCY MANAGEMENT AGENCY SKAGIT COUNTY, WA (UNINCORPORATED AREAS)	FLOOD PROFILES MAIN STEM SKAGIT RIVER

REACH 1
ZONE A1

ELEVATION (FEET NGVD)

40

35

19.4

94,000

98,000

STREAM DISTANCE IN FEET ABOVE MOUTH OF SOUTH FORK SKAGIT RIVER

LEGEND

- 500 - YEAR FLOOD
- 100 - YEAR FLOOD
- 50 - YEAR FLOOD
- 10 - YEAR FLOOD
- STREAM BED
- CROSS SECTION LOCATION

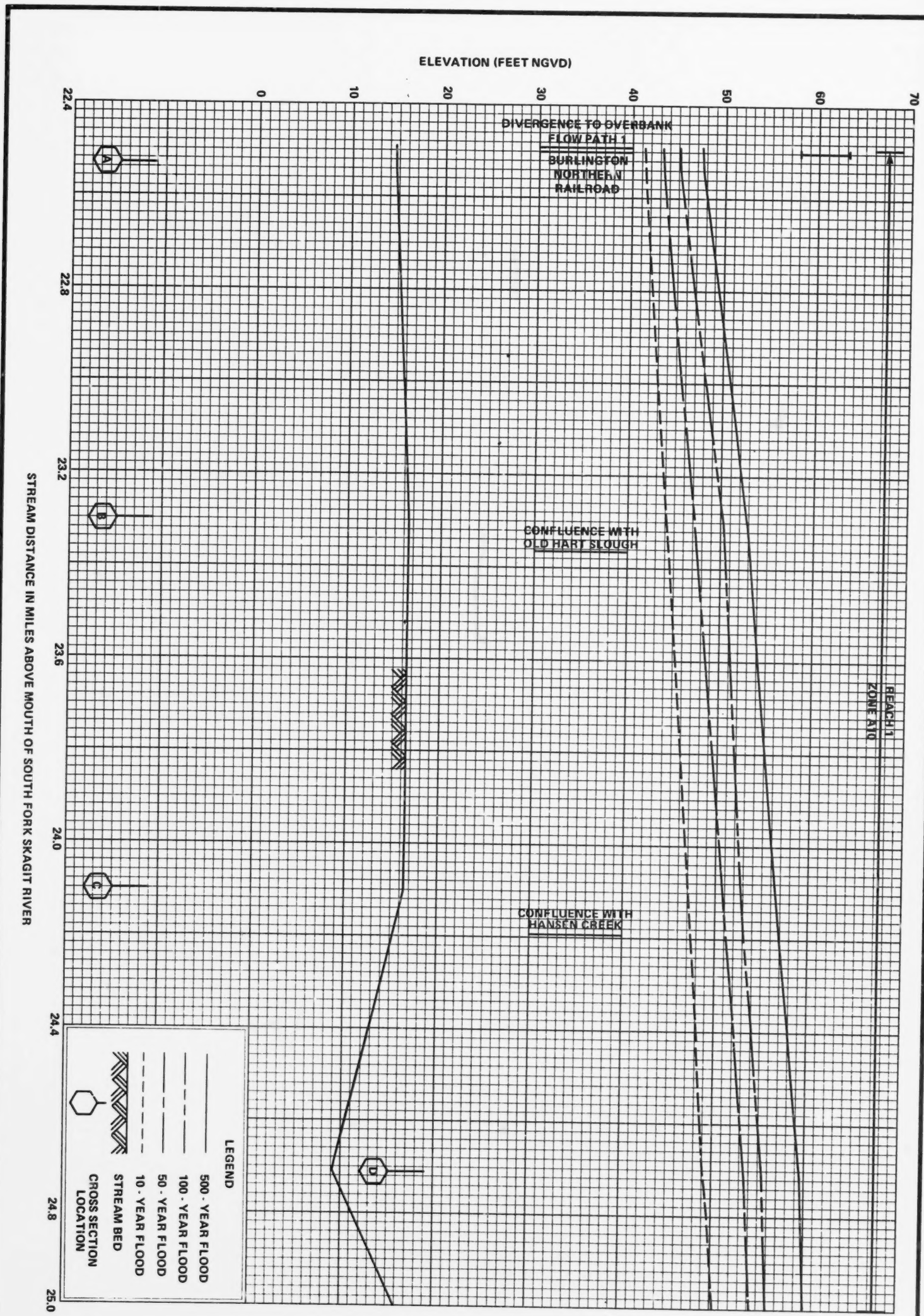
FLOOD PROFILES

MAIN STEM SKAGIT RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

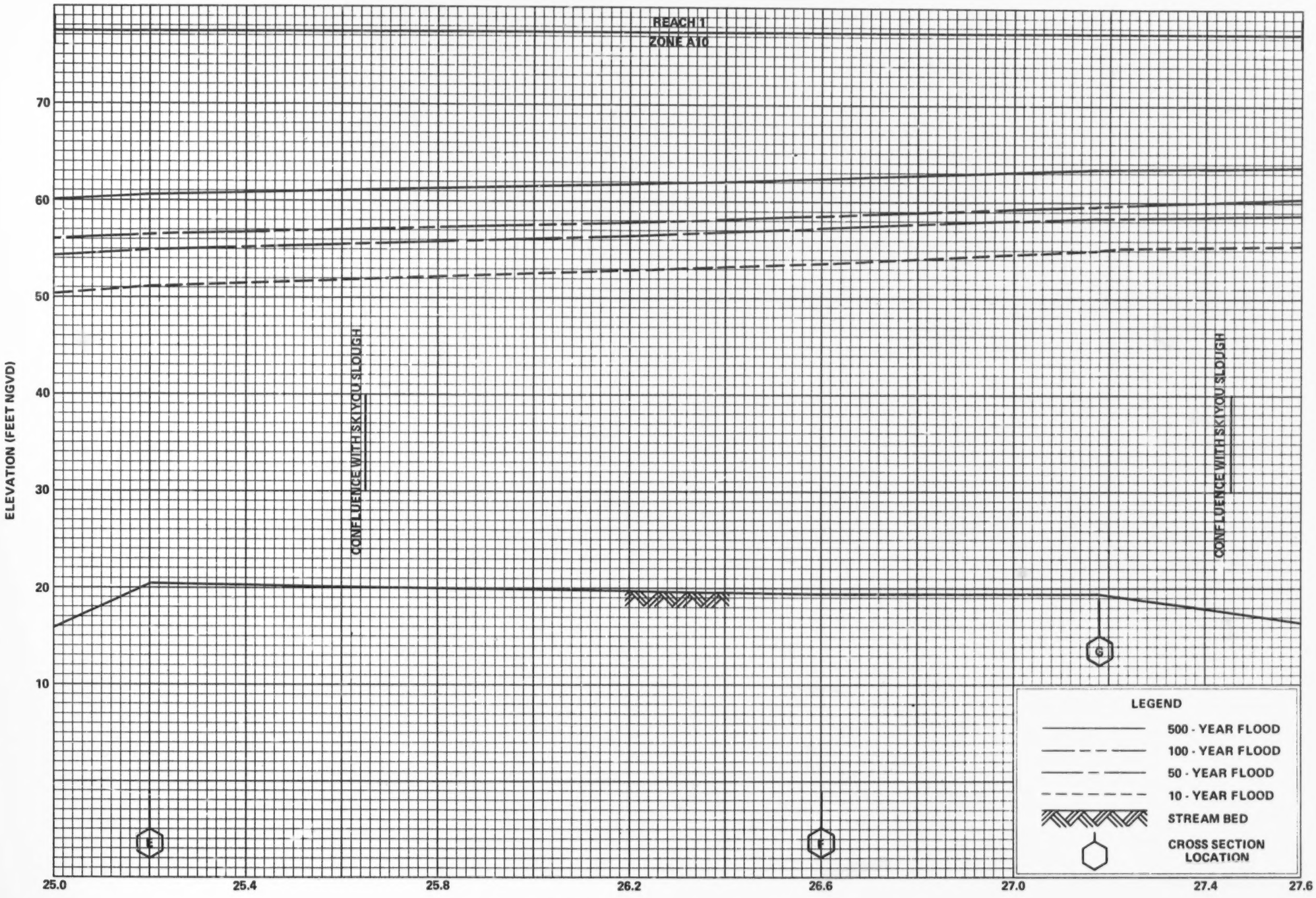
SKAGIT COUNTY, WA
(UNINCORPORATED AREAS)

13P



72

14P	FEDERAL EMERGENCY MANAGEMENT AGENCY SKAGIT COUNTY, WA (UNINCORPORATED AREAS)	FLOOD PROFILES SKAGIT RIVER



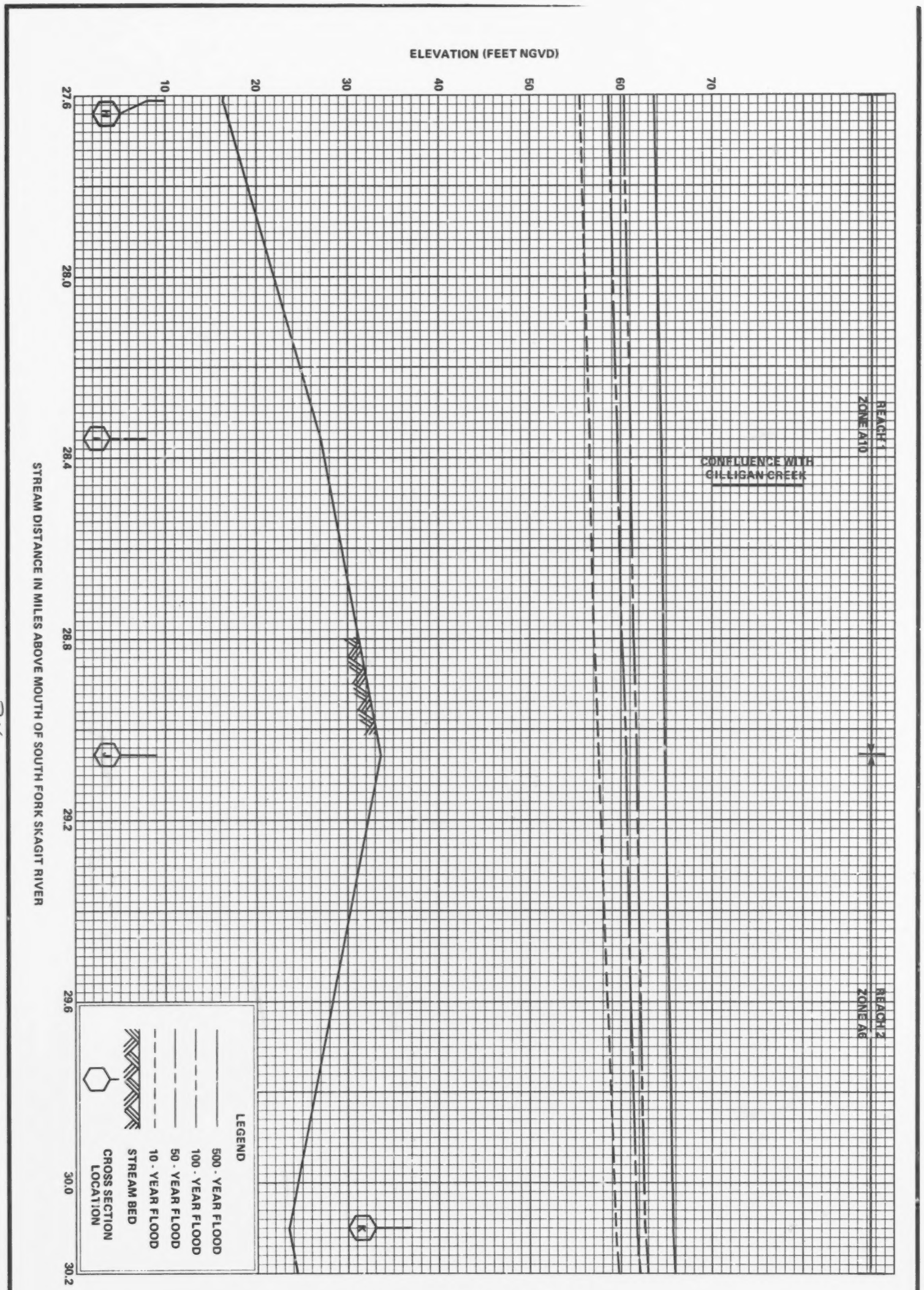
FLOOD PROFILES

SKAGIT RIVER

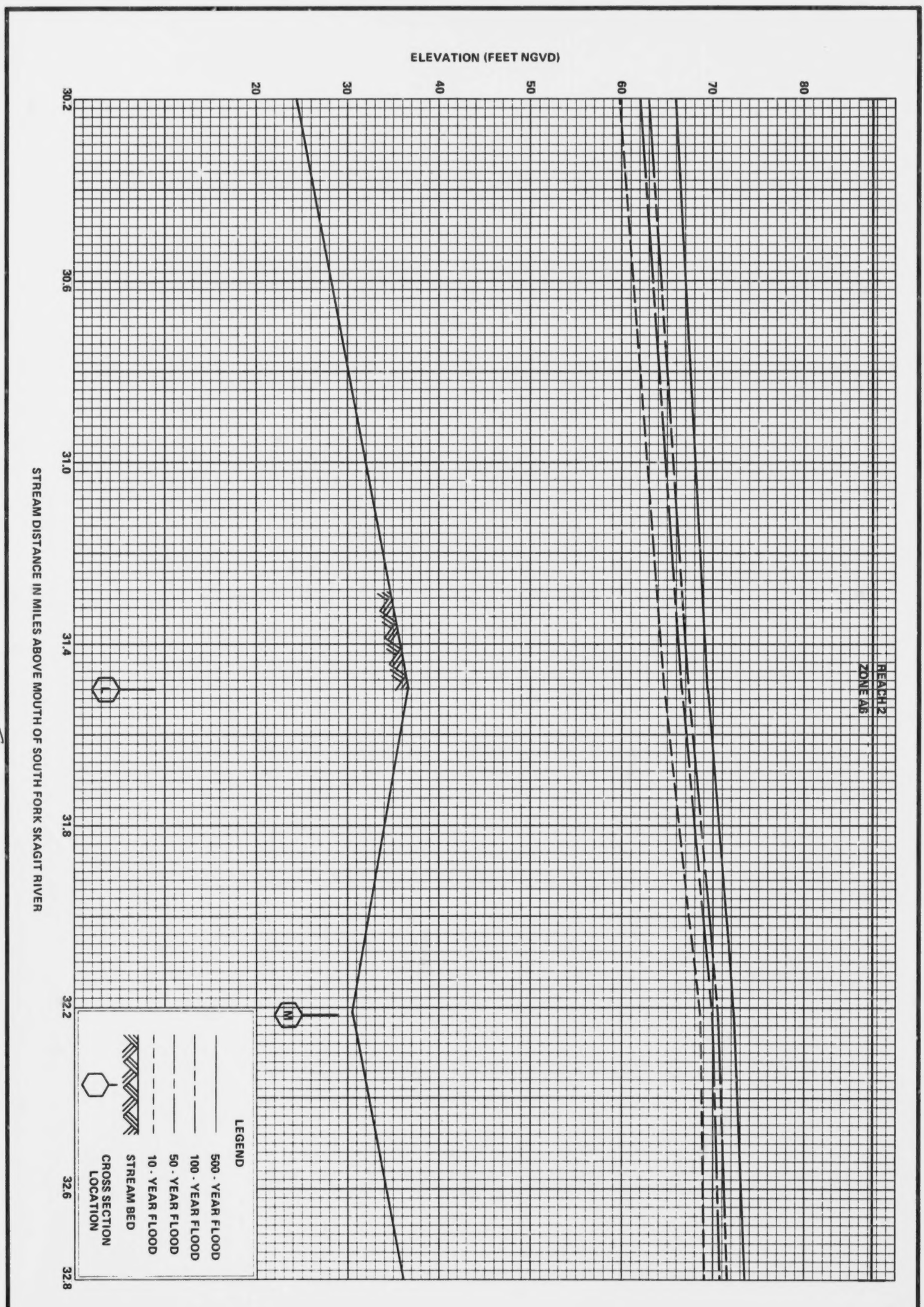
FEDERAL EMERGENCY MANAGEMENT AGENCY

SKAGIT COUNTY, WA
(UNINCORPORATED AREAS)

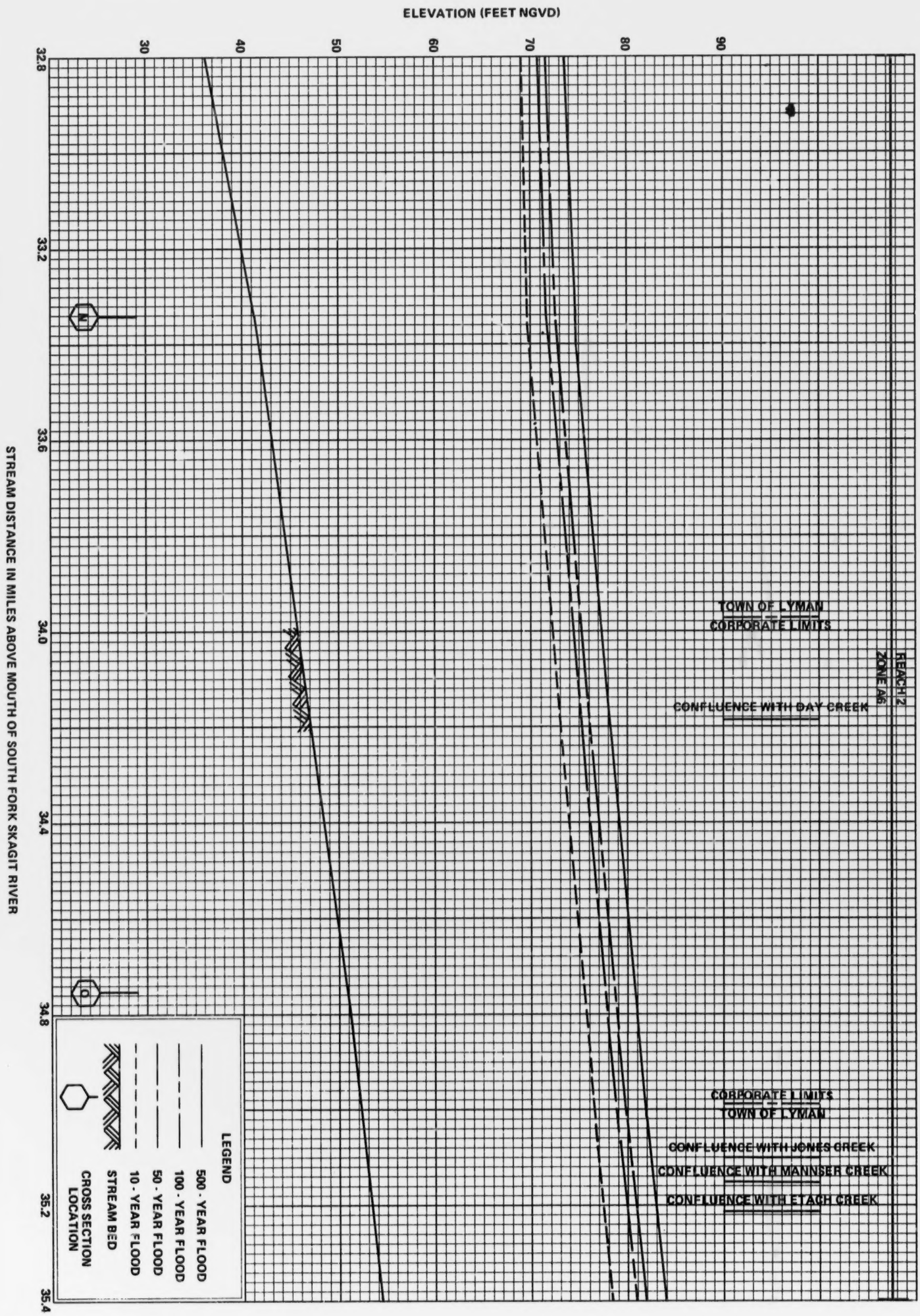
15P



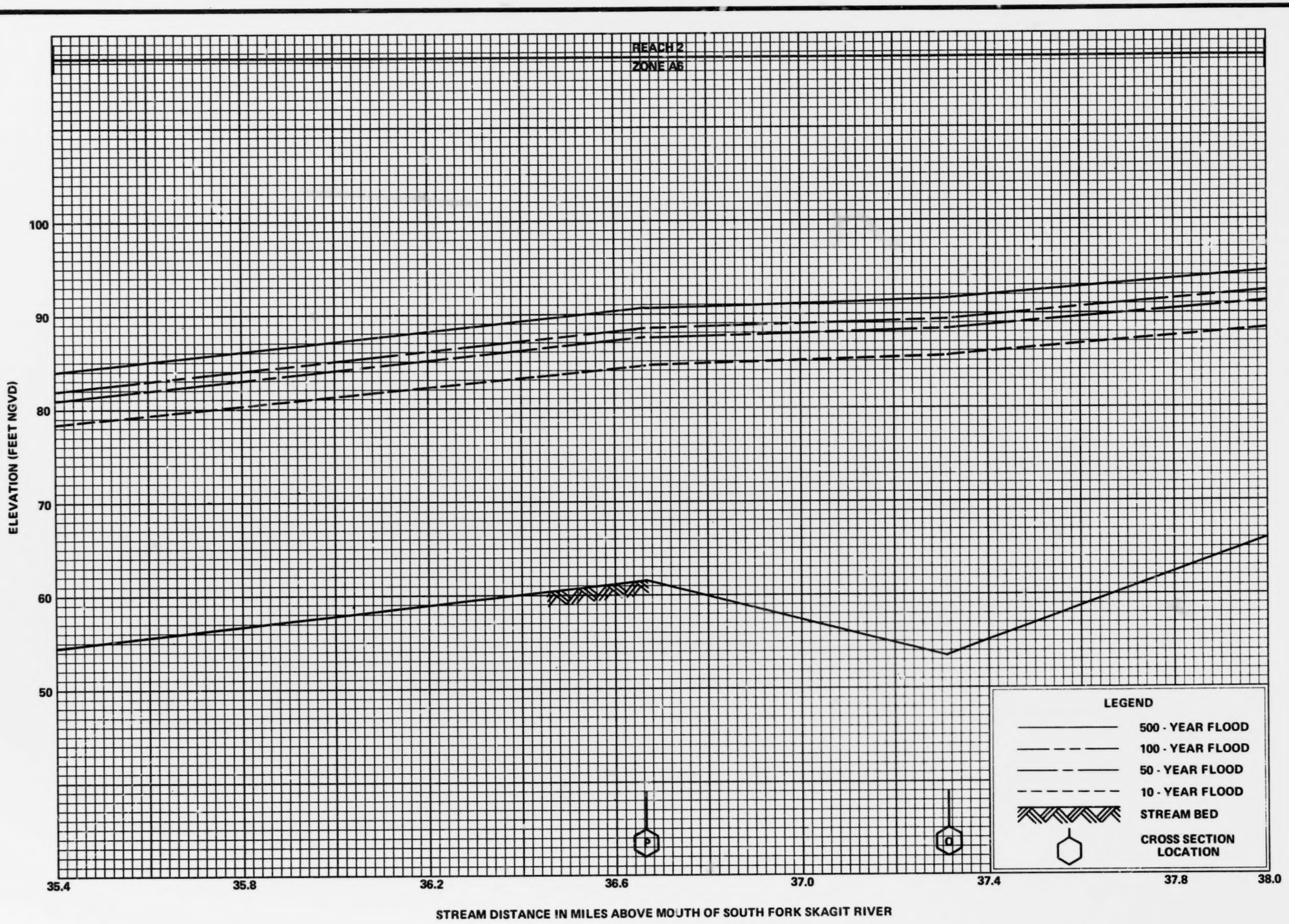
15P	FEDERAL EMERGENCY MANAGEMENT AGENCY SKAGIT COUNTY, WA (UNINCORPORATED AREAS)	FLOOD PROFILES SKAGIT RIVER



17P	FEDERAL EMERGENCY MANAGEMENT AGENCY SKAGIT COUNTY, WA (UNINCORPORATED AREAS)	FLOOD PROFILES SKAGIT RIVER



18P	FEDERAL EMERGENCY MANAGEMENT AGENCY SKAGIT COUNTY, WA (UNINCORPORATED AREAS)	FLOOD PROFILES SKAGIT RIVER



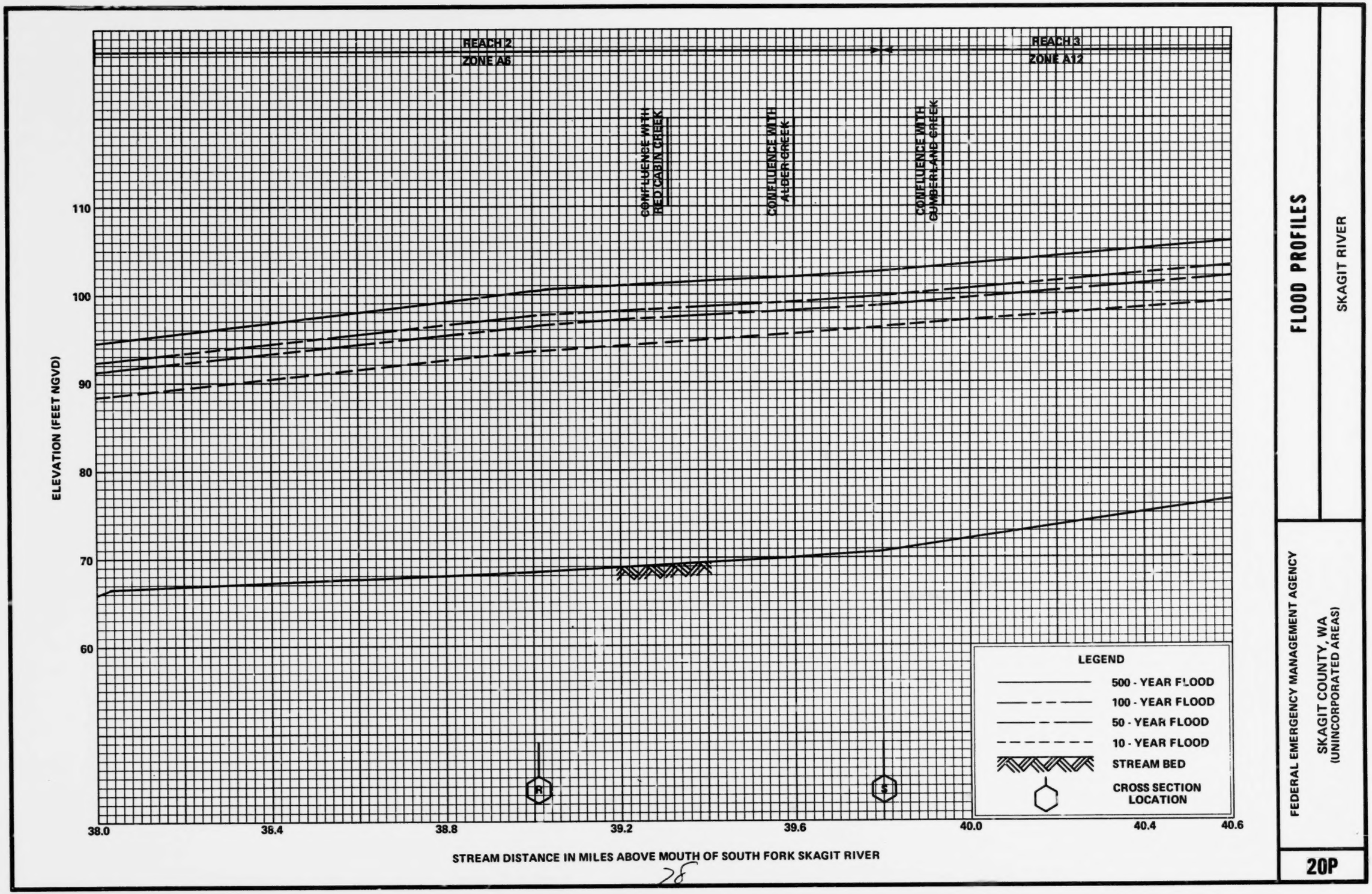
FLOOD PROFILES

SKAGIT RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

SKAGIT COUNTY, WA
(UNINCORPORATED AREAS)

19P



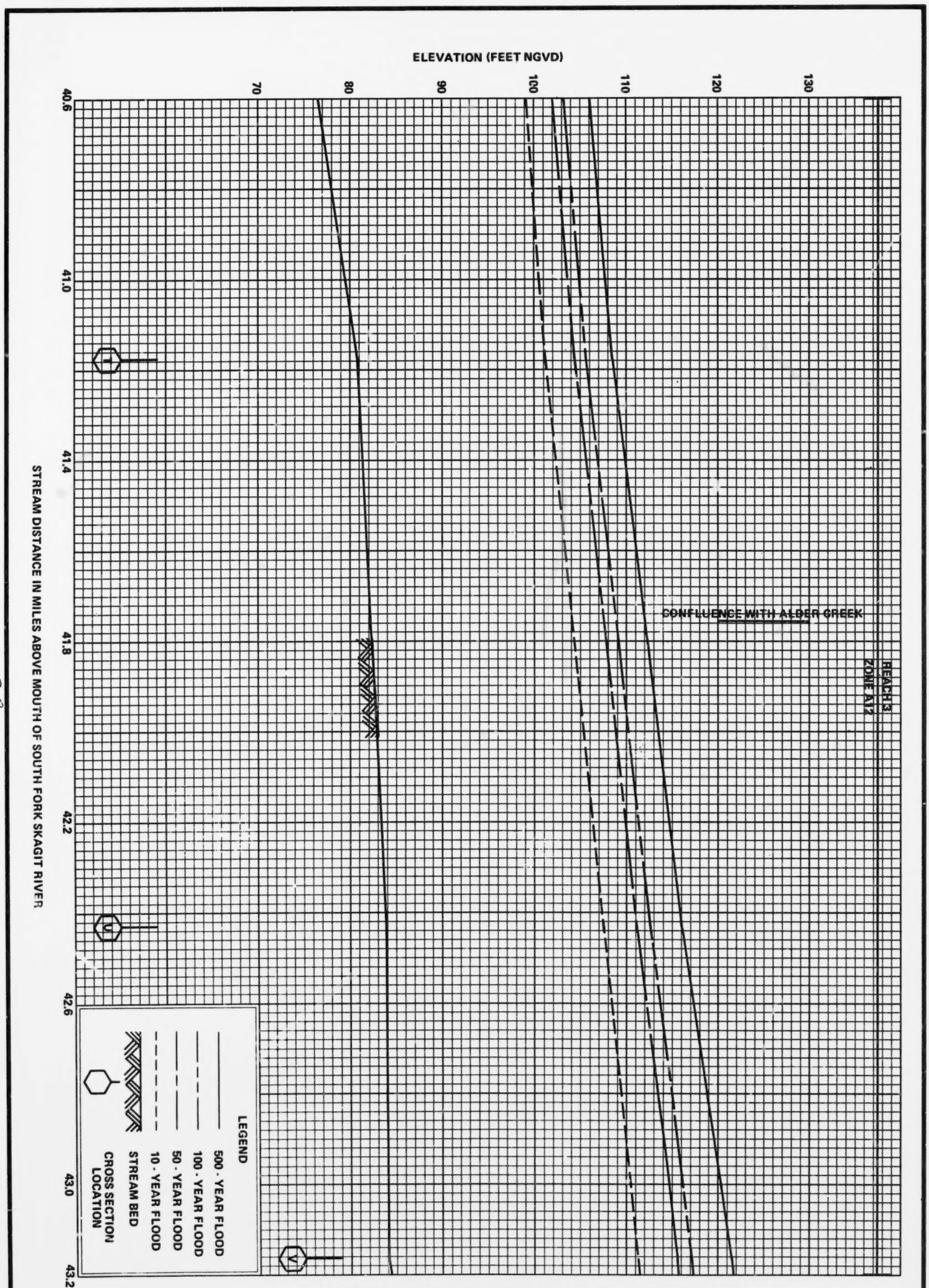
FLOOD PROFILES

SKAGIT RIVER

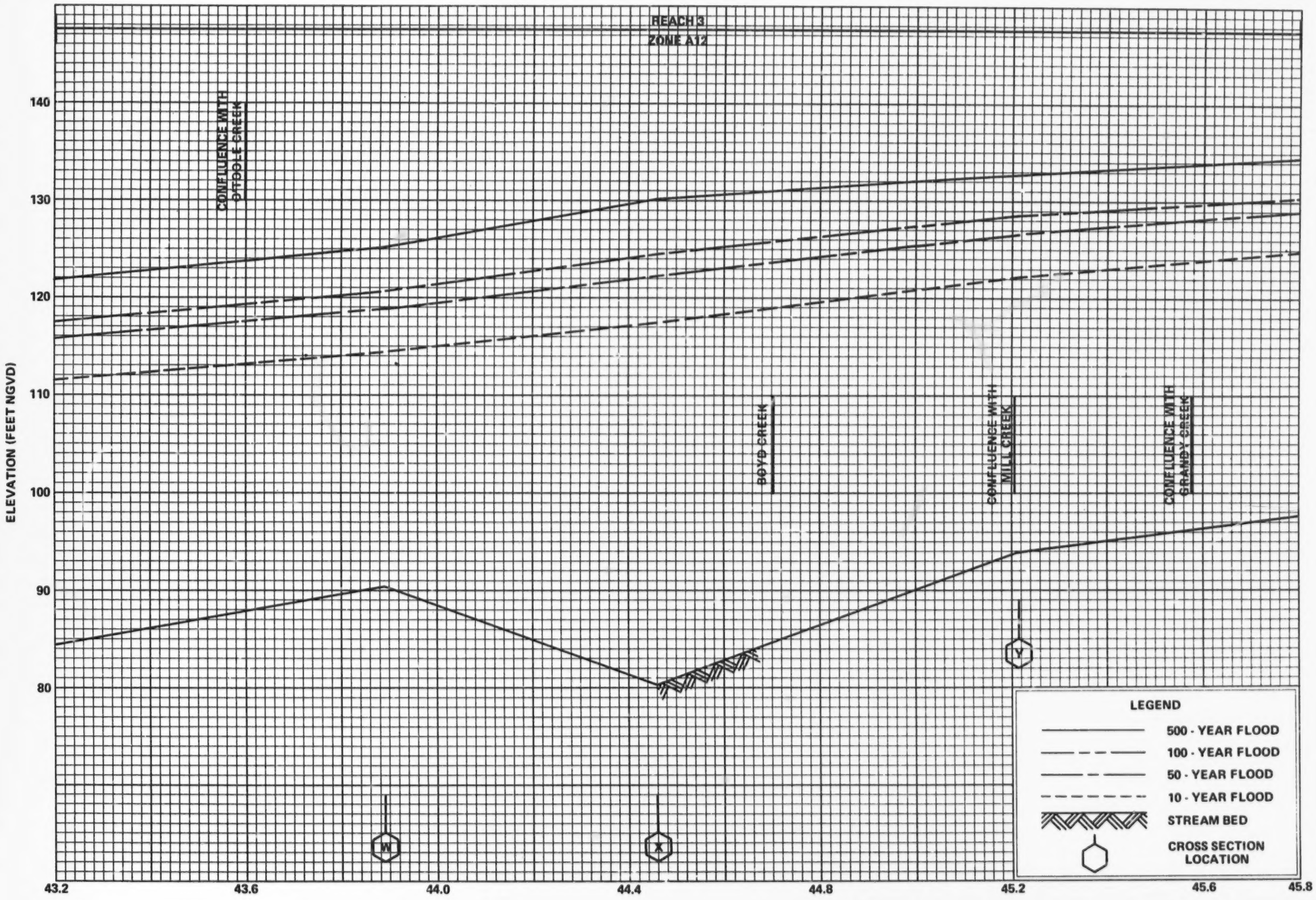
FEDERAL EMERGENCY MANAGEMENT AGENCY

SKAGIT COUNTY, WA
(UNINCORPORATED AREAS)

20P



21P	FEDERAL EMERGENCY MANAGEMENT AGENCY SKAGIT COUNTY, WA (UNINCORPORATED AREAS)	**FLOOD PROFILES** SKAGIT RIVER



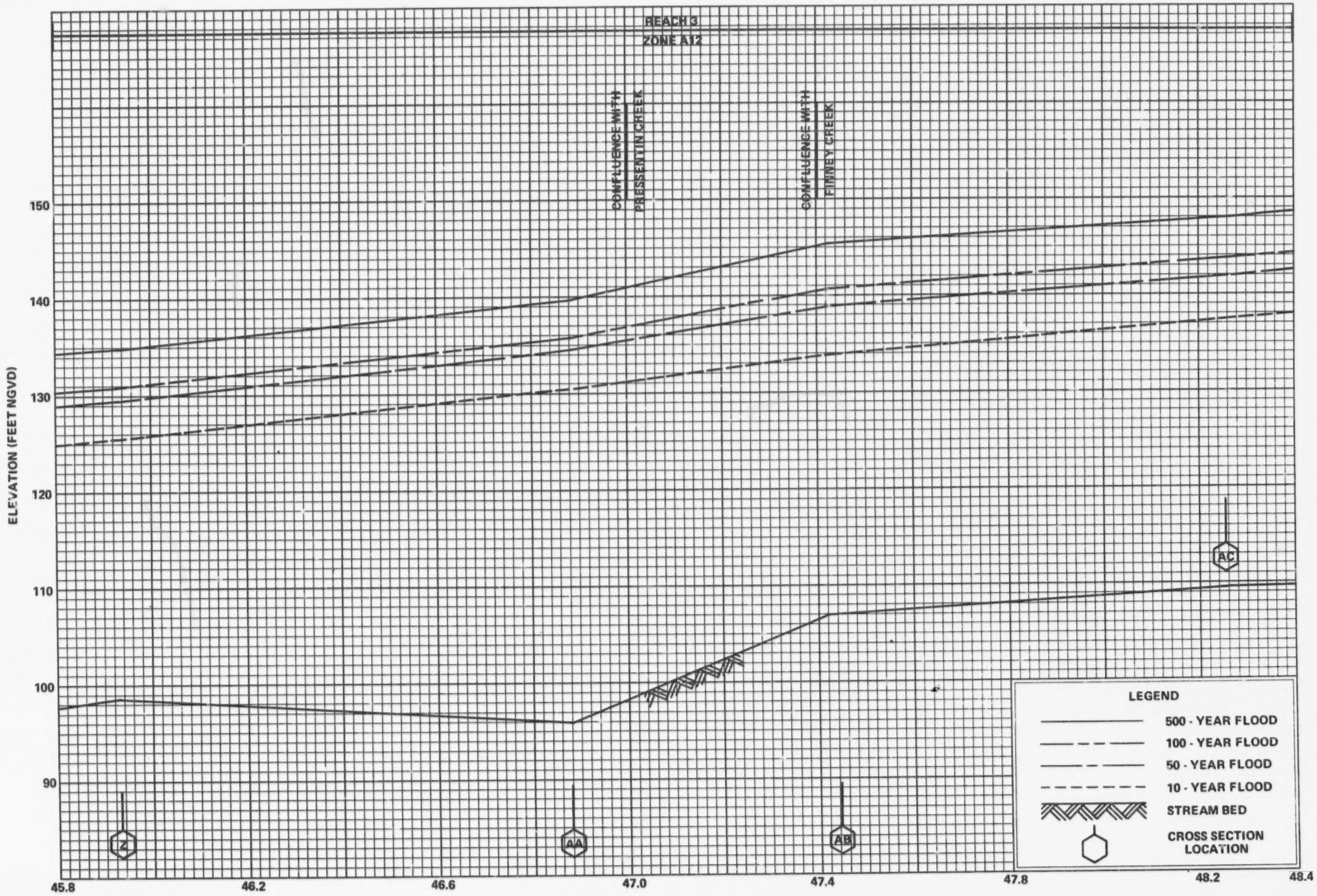
FLOOD PROFILES

SKAGIT RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

SKAGIT COUNTY, WA
(UNINCORPORATED AREAS)

22P



FLOOD PROFILES

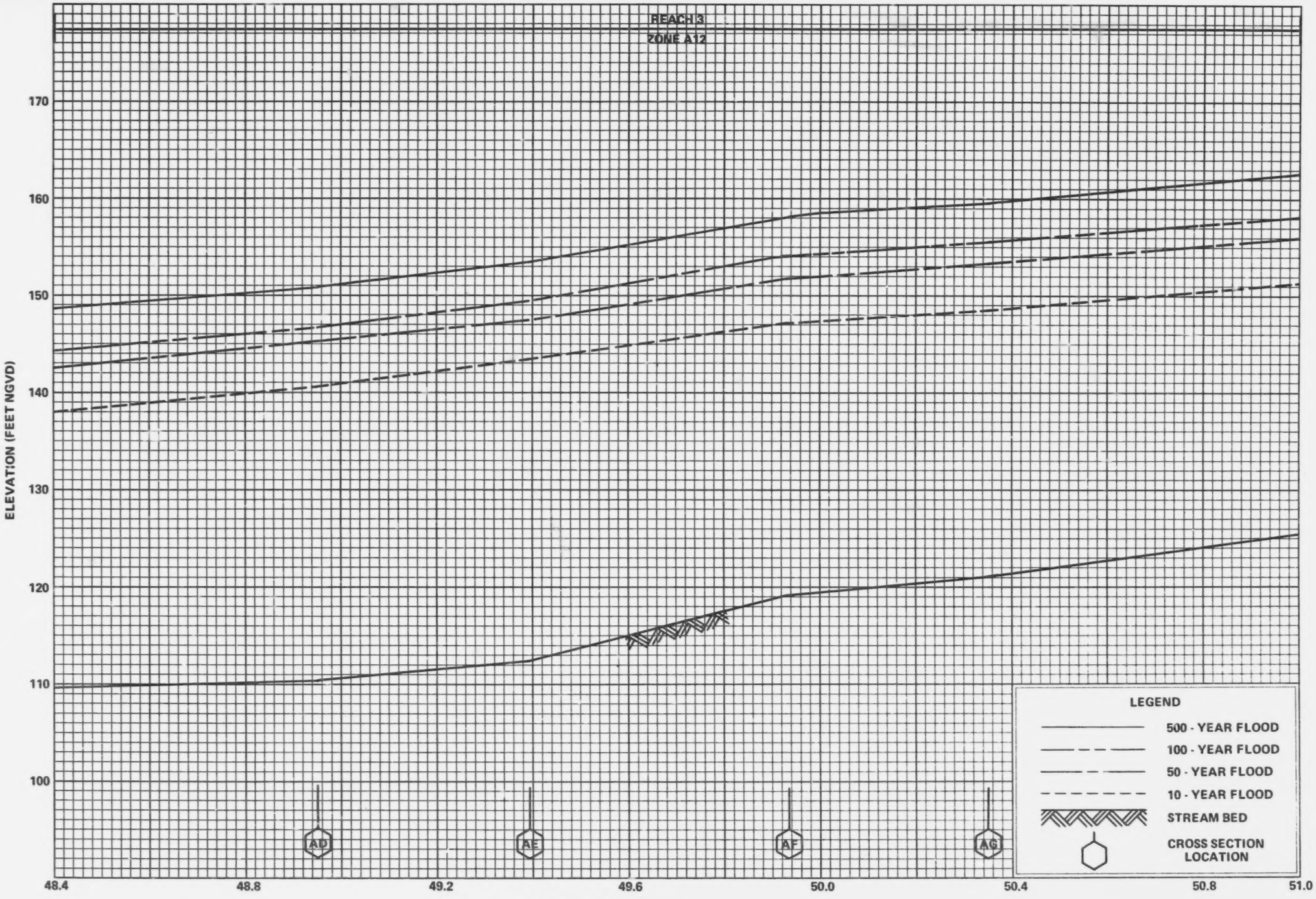
SKAGIT RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

SKAGIT COUNTY, WA
(UNINCORPORATED AREAS)

23P

REACH 3
ZONE A12



STREAM DISTANCE IN MILES ABOVE MOUTH OF SOUTH FORK SKAGIT RIVER

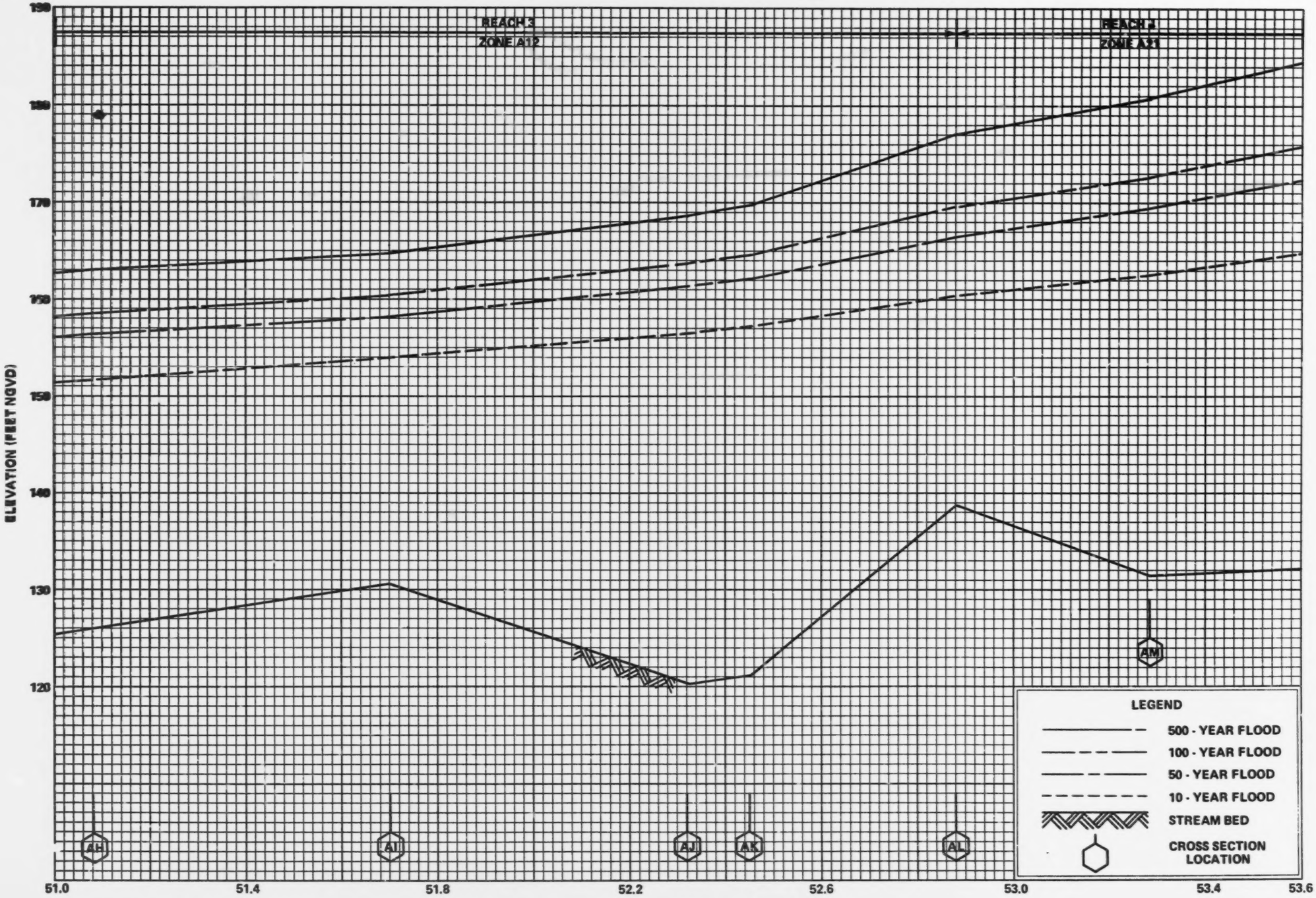
EJ

FLOOD PROFILES

SKAGIT RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

SKAGIT COUNTY, WA
(UNINCORPORATED AREAS)



FLOOD PROFILES

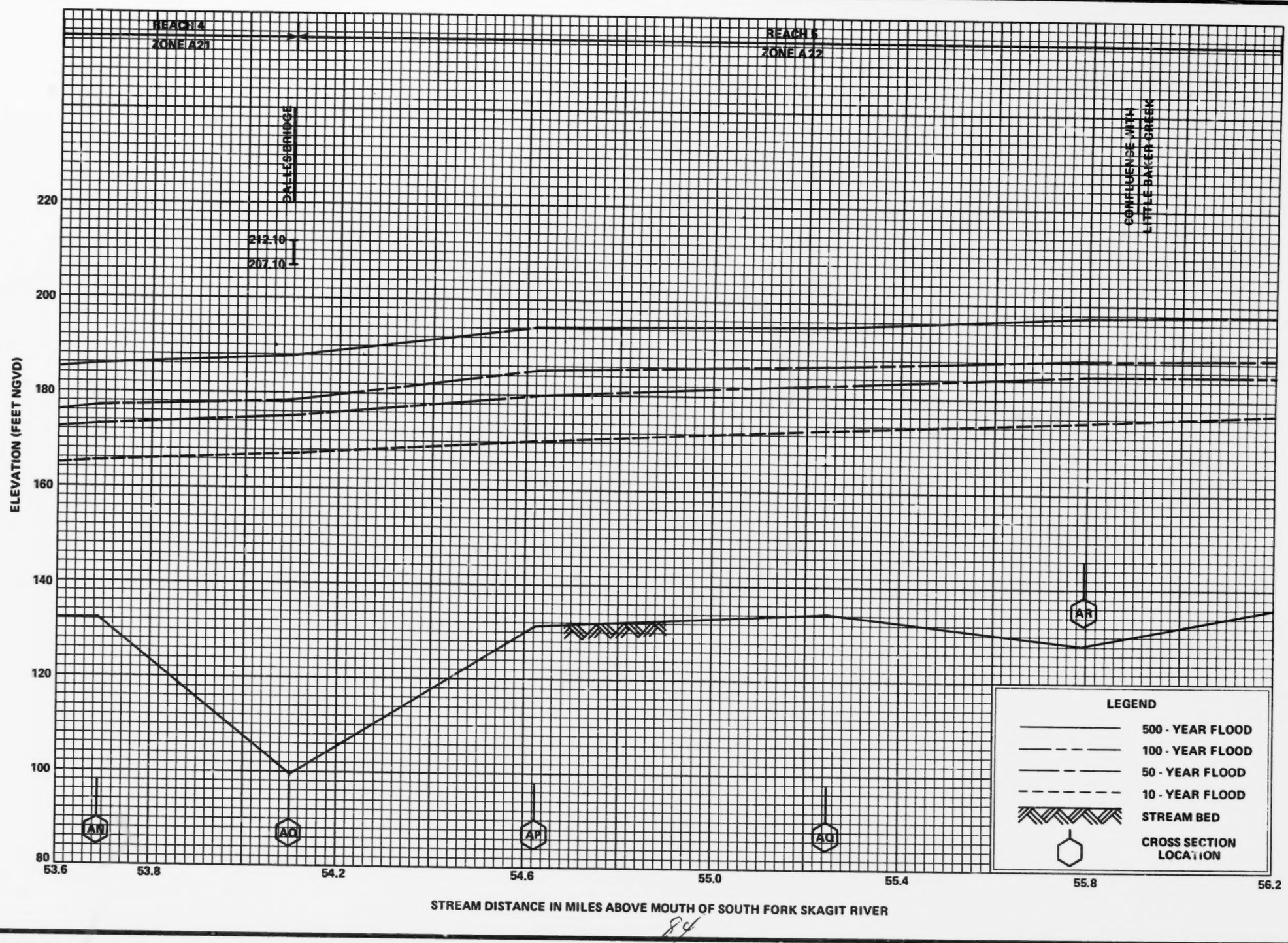
SKAGIT RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

SKAGIT COUNTY, WA
(UNINCORPORATED AREAS)

25P

83



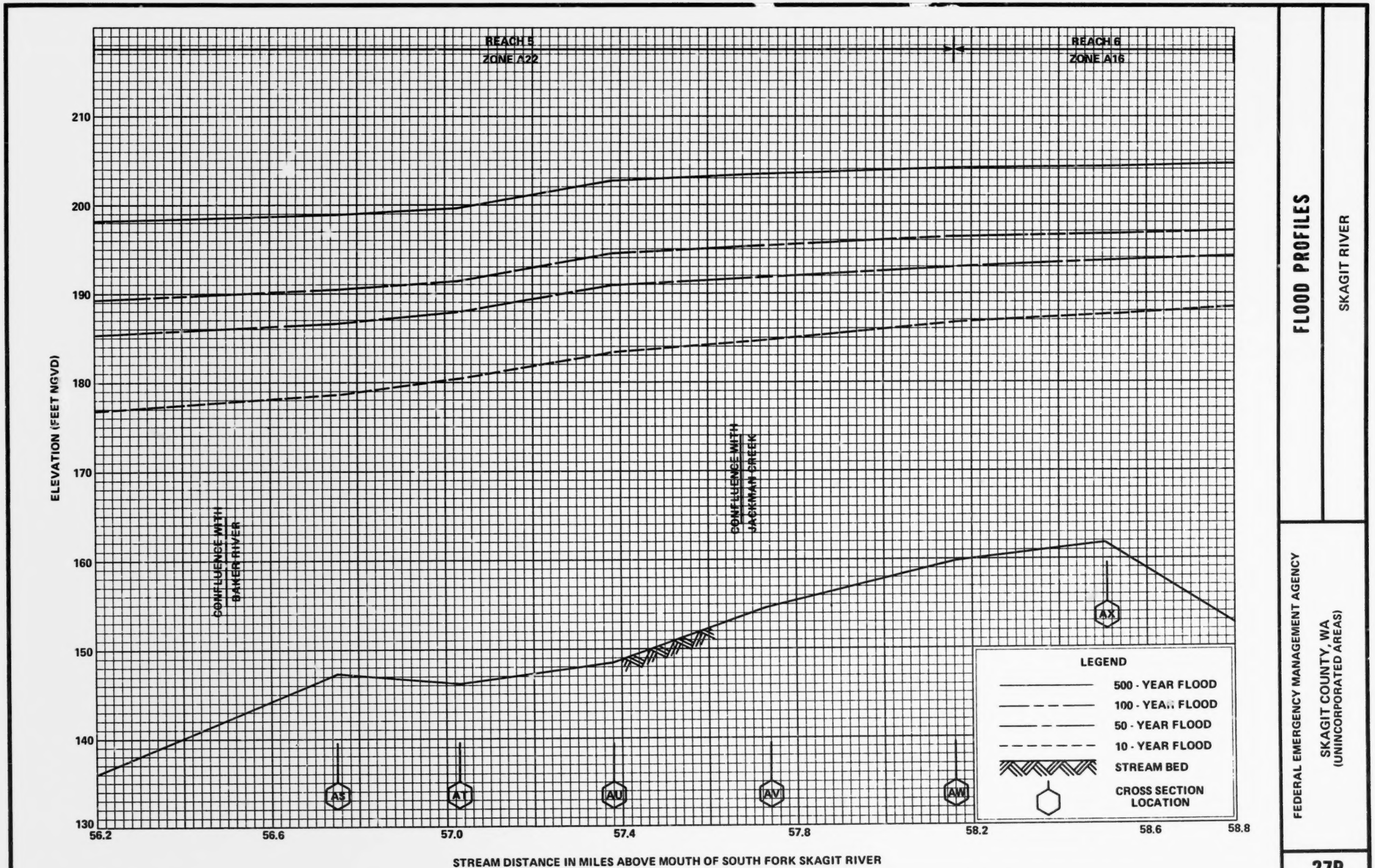
FLOOD PROFILES

SKAGIT RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

SKAGIT COUNTY, WA
(UNINCORPORATED AREAS)

26P



FLOOD PROFILES

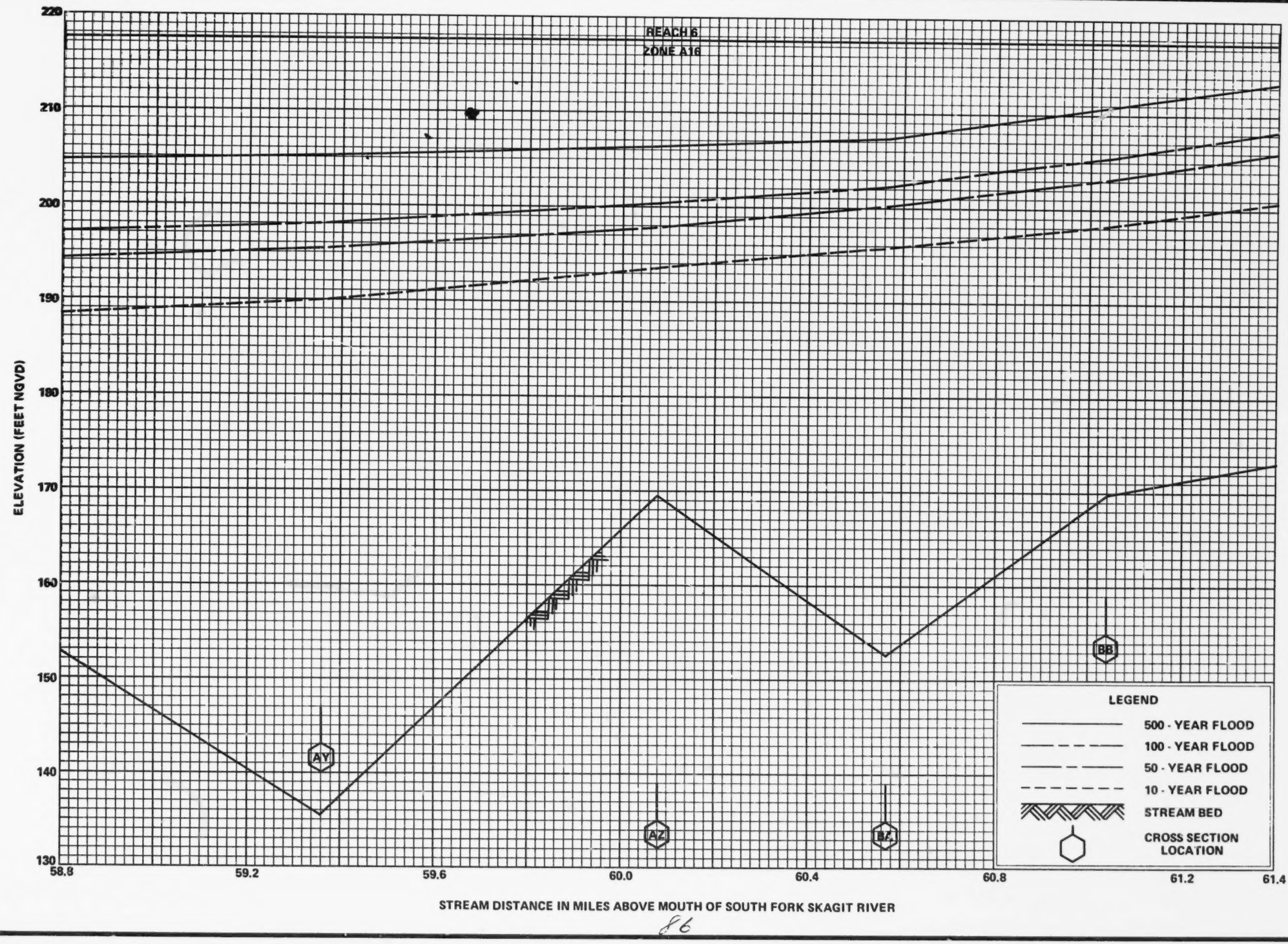
SKAGIT RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

SKAGIT COUNTY, WA
(UNINCORPORATED AREAS)

27P

85



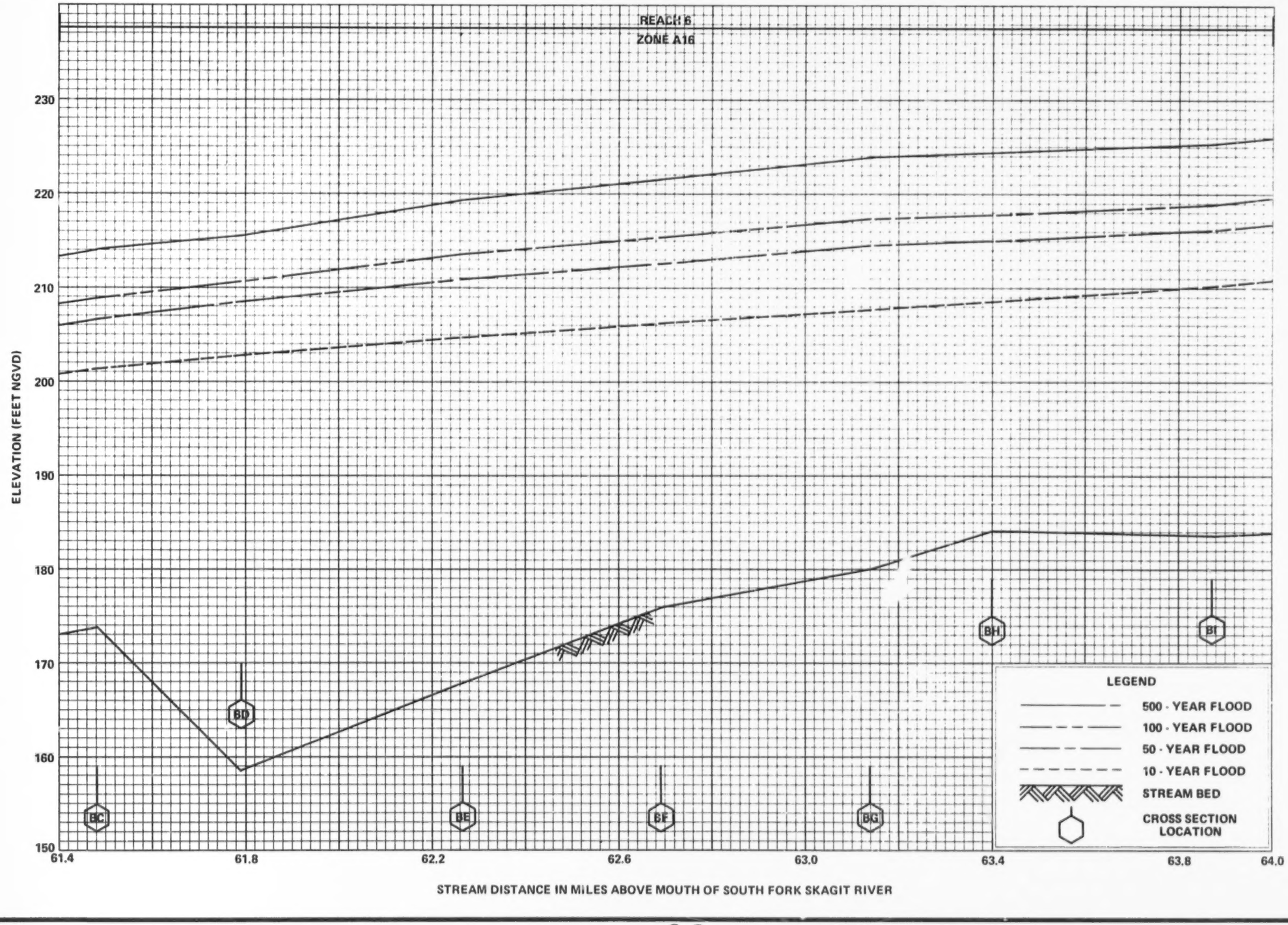
FLOOD PROFILES

SKAGIT RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

SKAGIT COUNTY, WA
(UNINCORPORATED AREAS)

28P



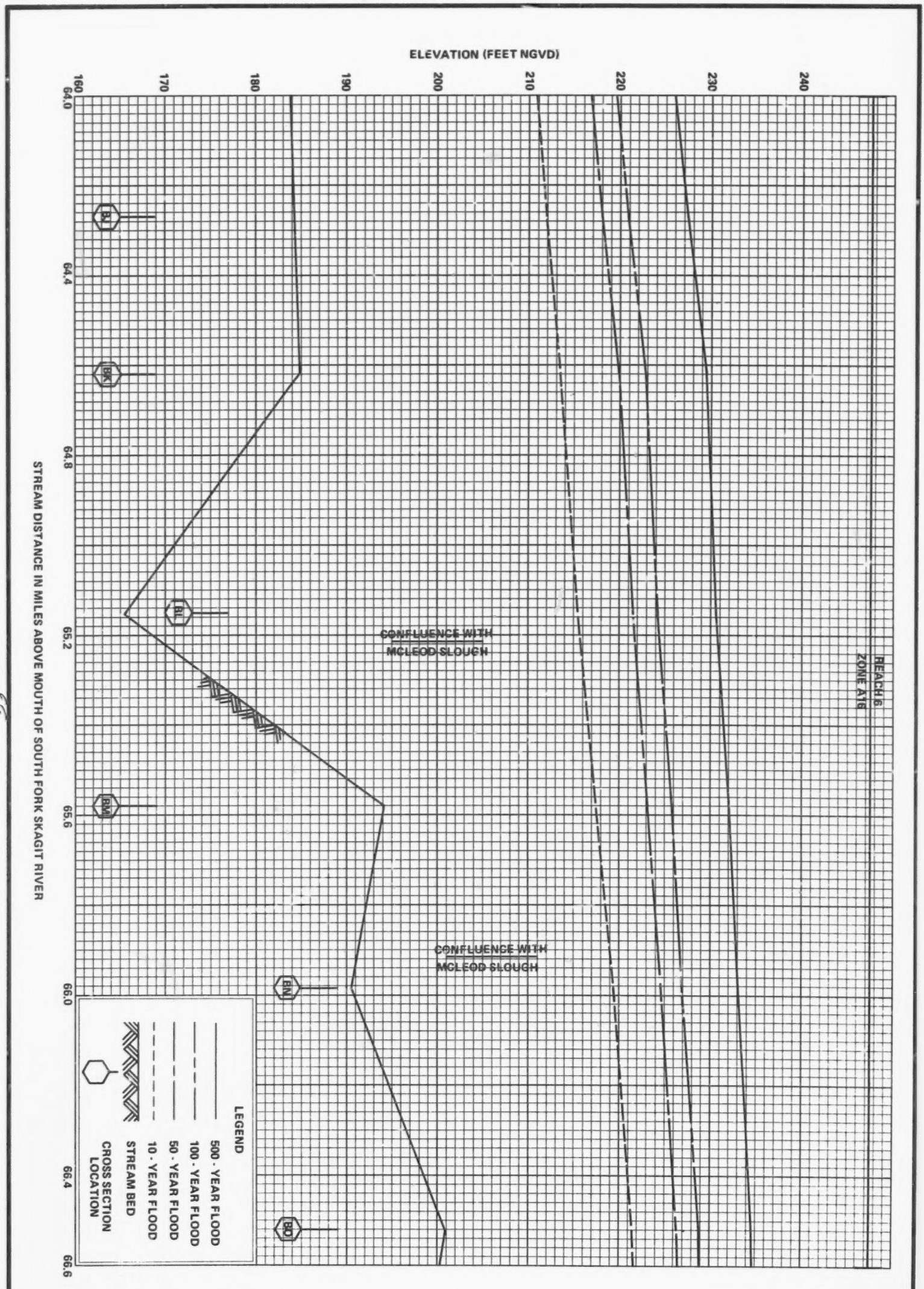
FLOOD PROFILES

SKAGIT RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

SKAGIT COUNTY, WA
(UNINCORPORATED AREAS)

29P



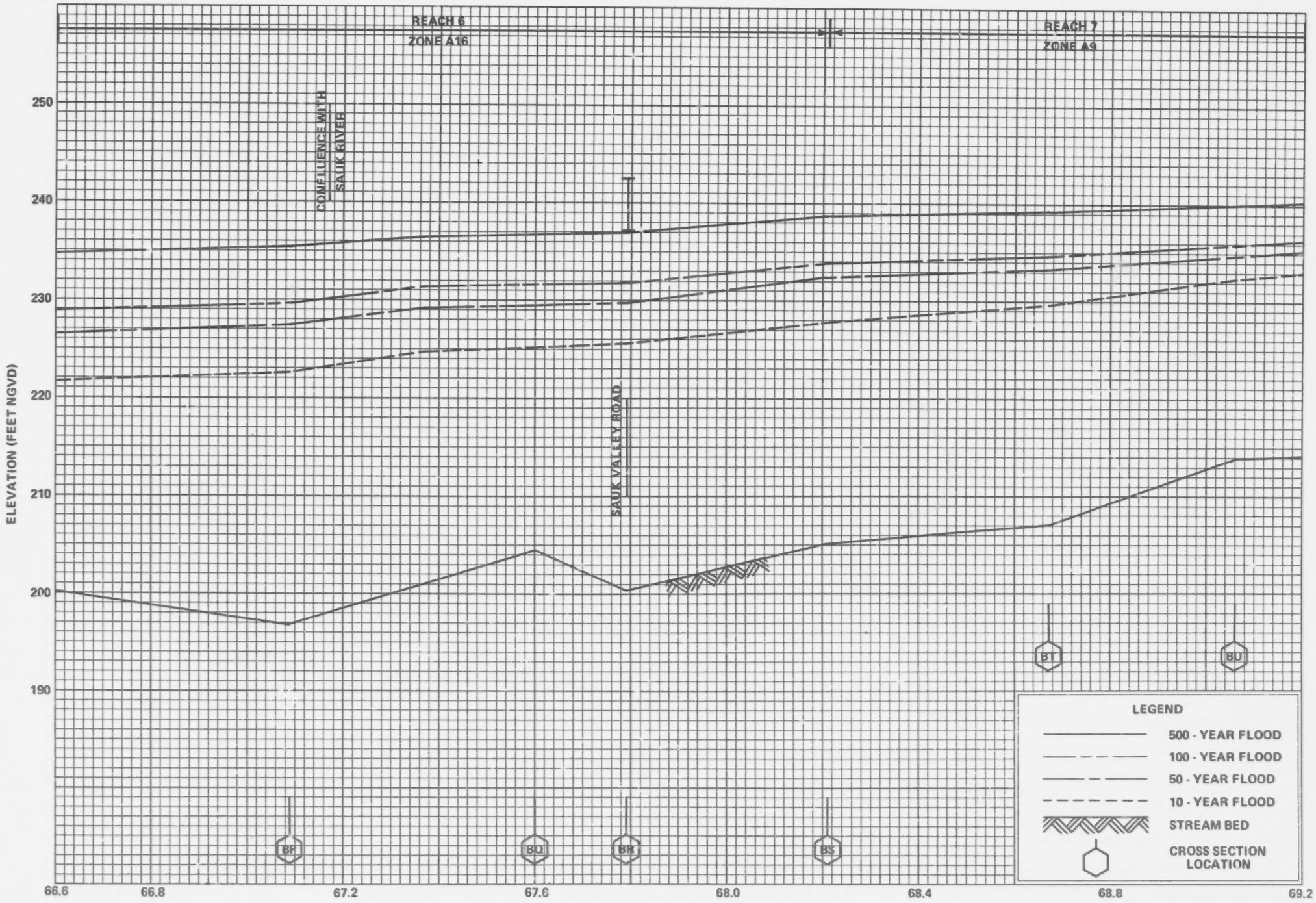
30P

FEDERAL EMERGENCY MANAGEMENT AGENCY

SKAGIT COUNTY, WA
(UNINCORPORATED AREAS)

FLOOD PROFILES

SKAGIT RIVER



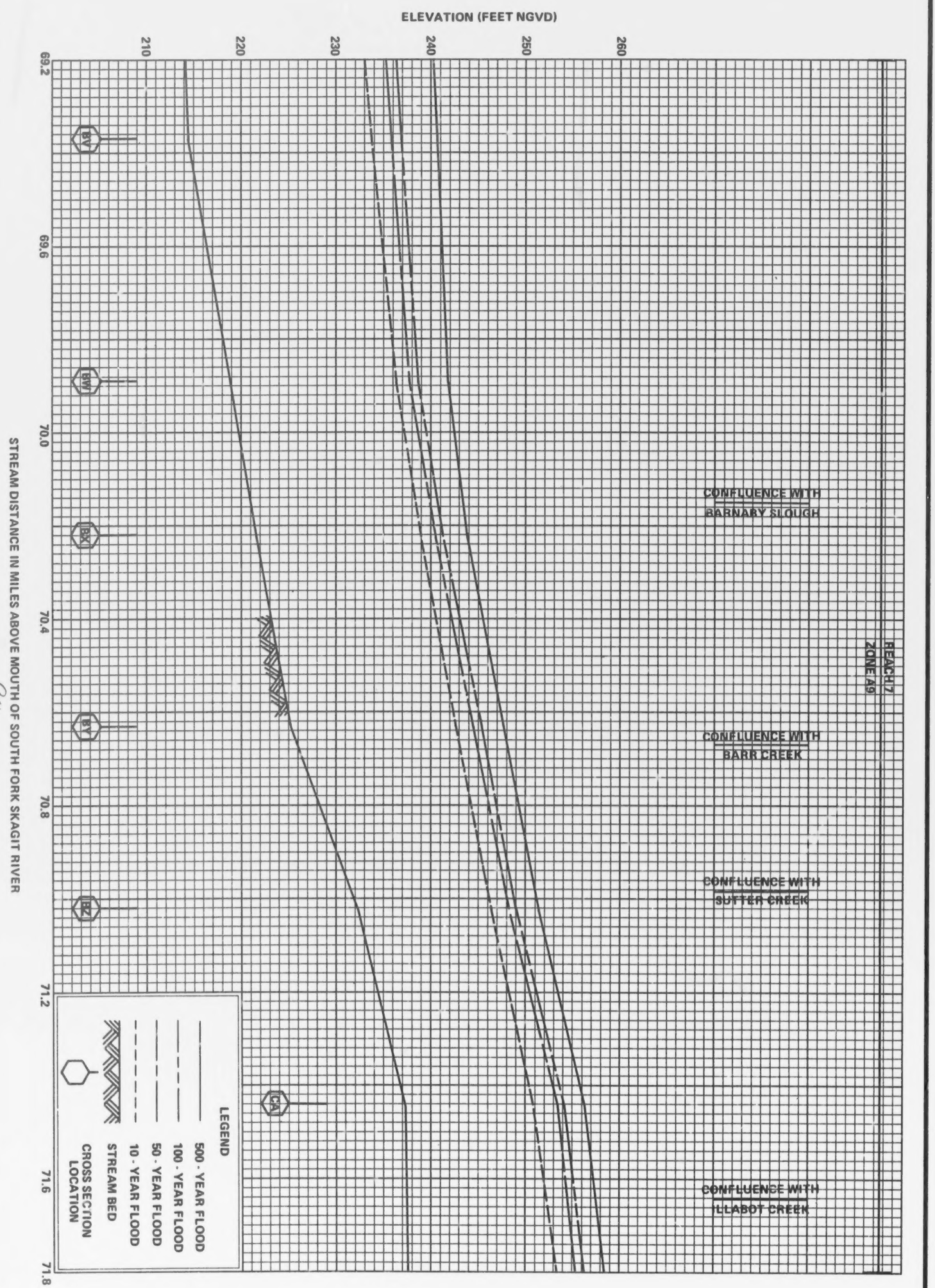
FLOOD PROFILES

SKAGIT RIVER

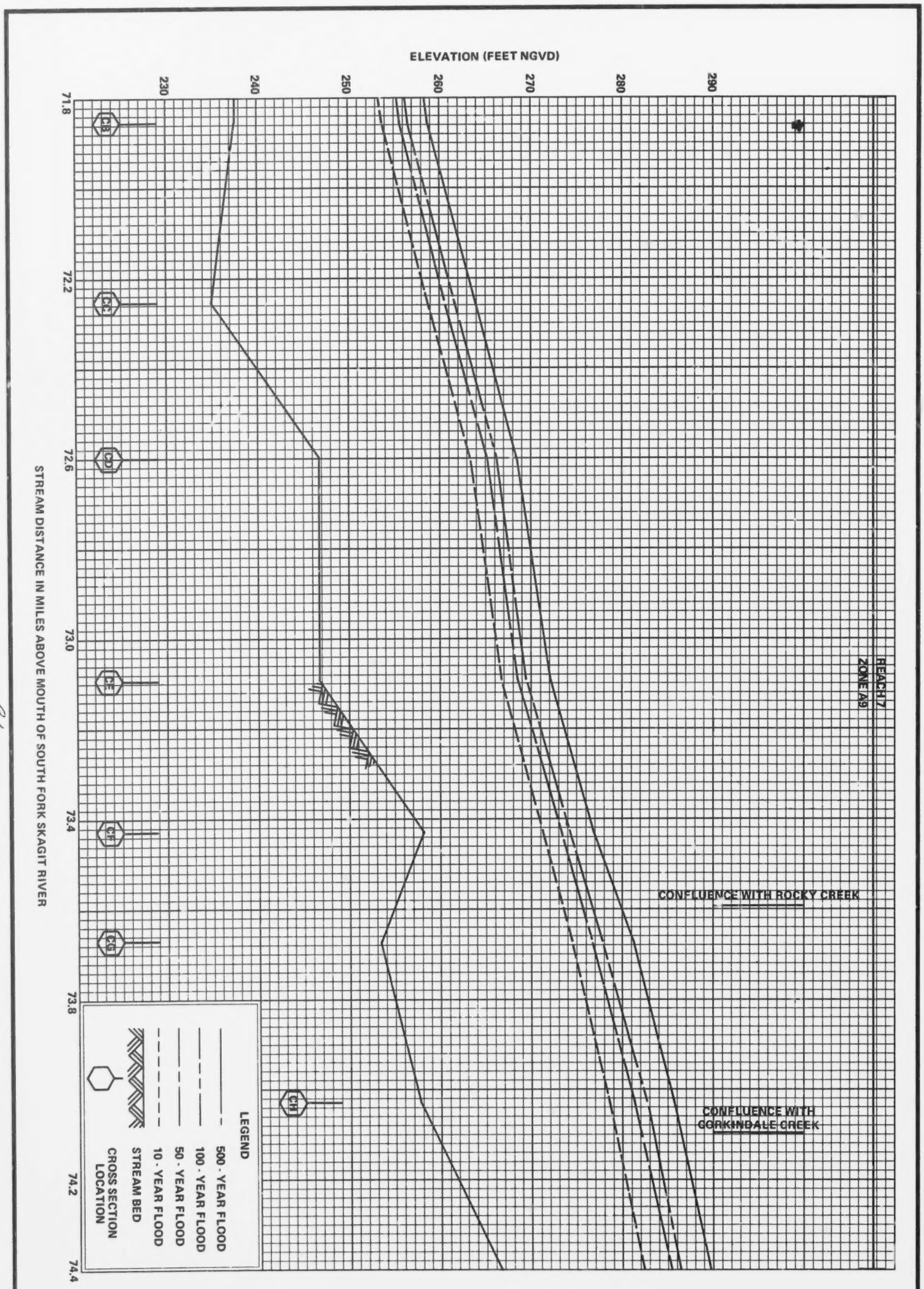
FEDERAL EMERGENCY MANAGEMENT AGENCY

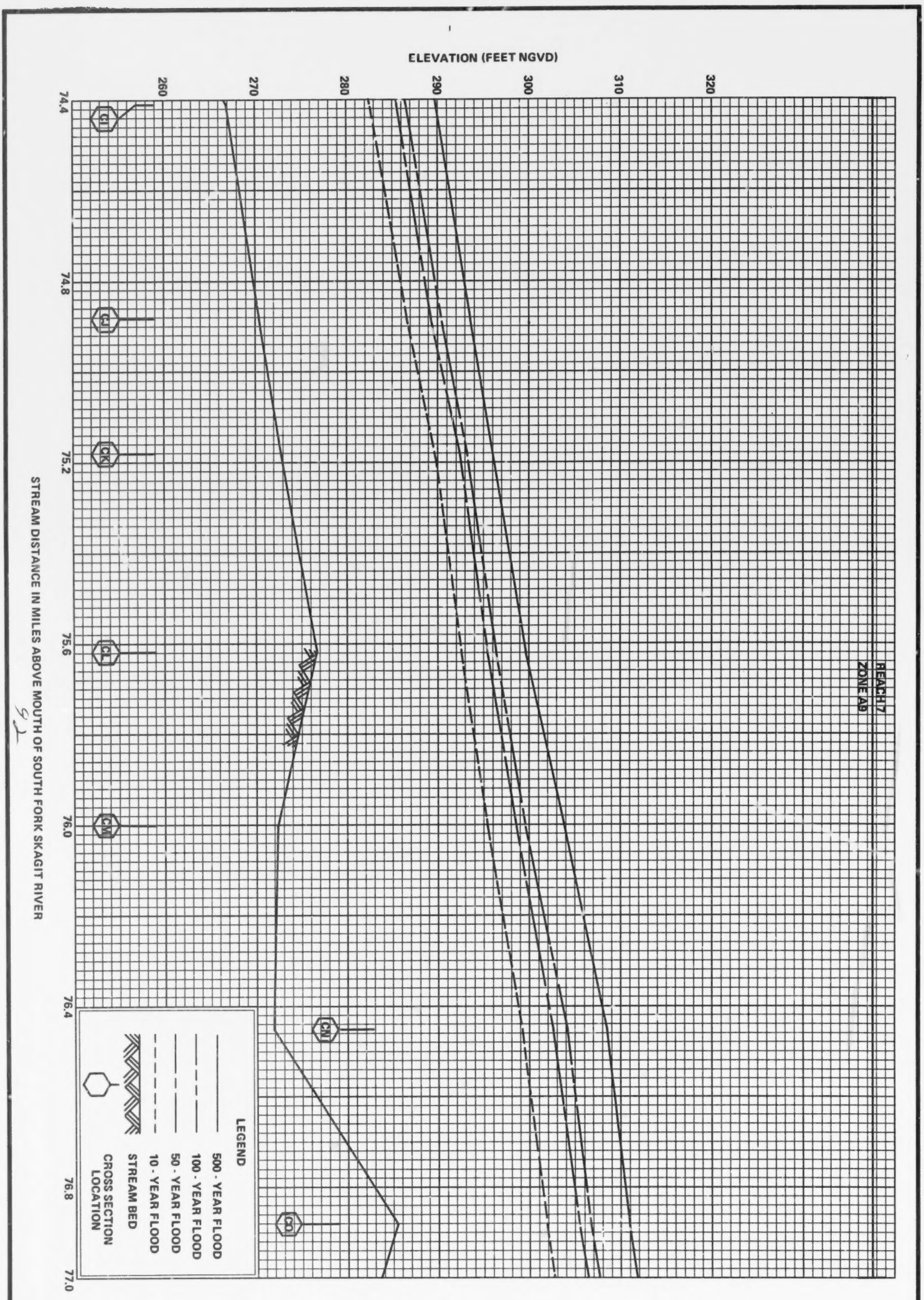
SKAGIT COUNTY, WA
(UNINCORPORATED AREAS)

31P

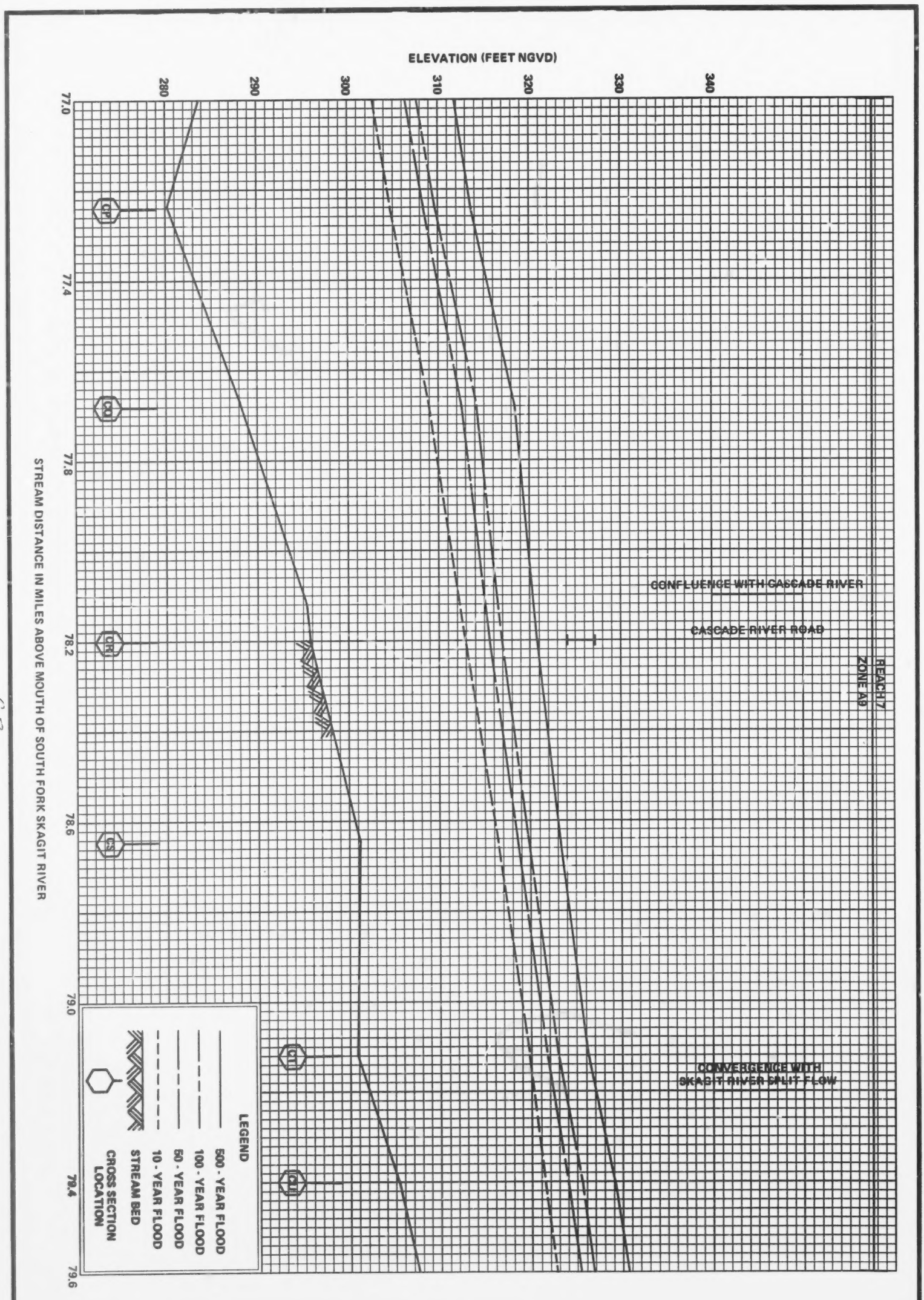


32P	FEDERAL EMERGENCY MANAGEMENT AGENCY SKAGIT COUNTY, WA (UNINCORPORATED AREAS)	**FLOOD PROFILES** SKAGIT RIVER

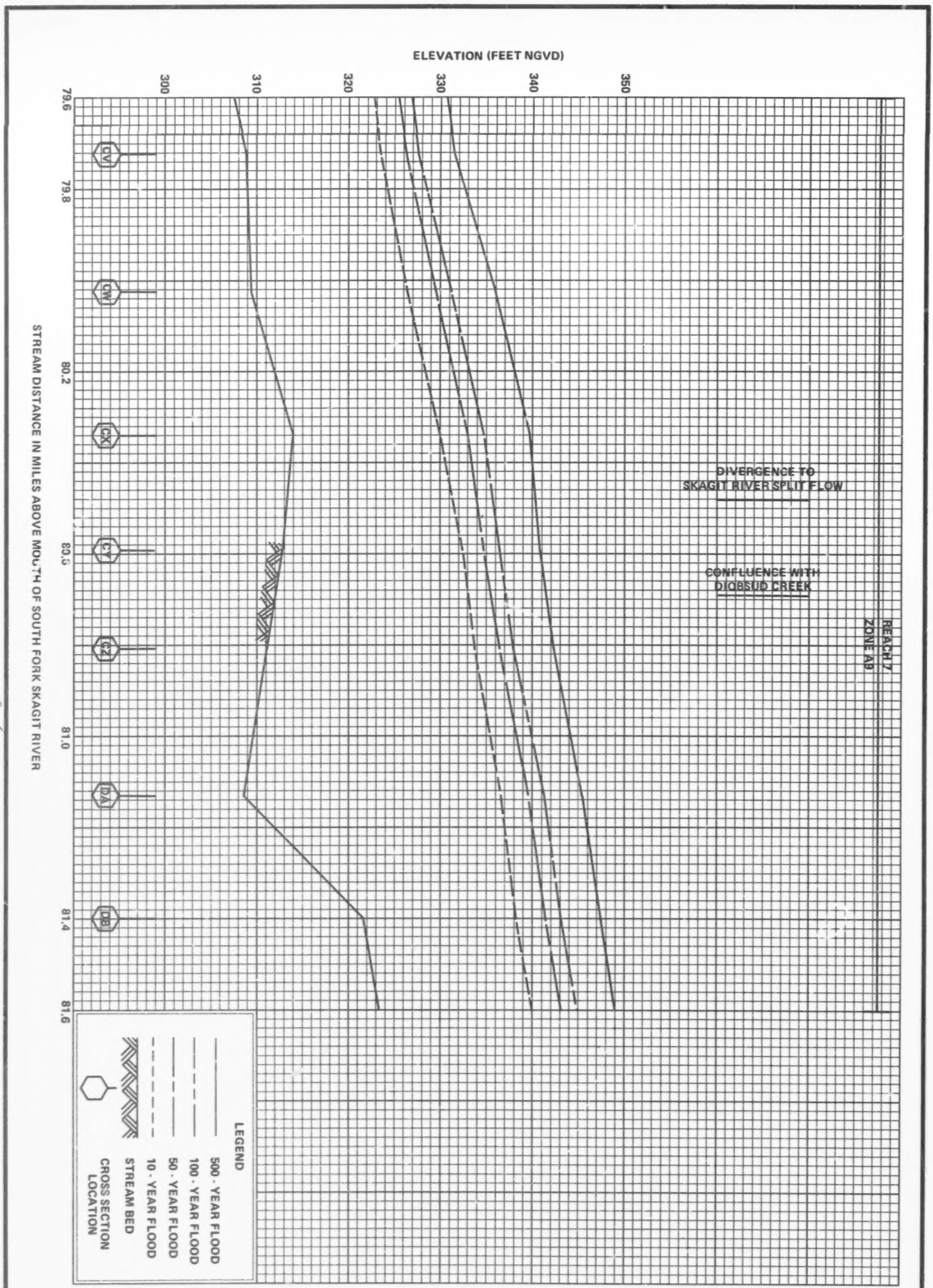

ELEVATION (FEET NGVD)
230
240
250
260
270
280
290
71.8
72.2
72.6
73.0
73.4
73.8
74.2
74.4
STREAM DISTANCE IN MILES ABOVE MOUTH OF SOUTH FORK SKAGIT RIVER
CB
CC
CD
CE
CF
CG
CH
REACH 17
ZONE A9
CONFLUENCE WITH ROCKY CREEK
CONFLUENCE WITH
GORKINDALE CREEK
LEGEND
500 - YEAR FLOOD
100 - YEAR FLOOD
50 - YEAR FLOOD
10 - YEAR FLOOD
STREAM BED
CROSS SECTION
LOCATION



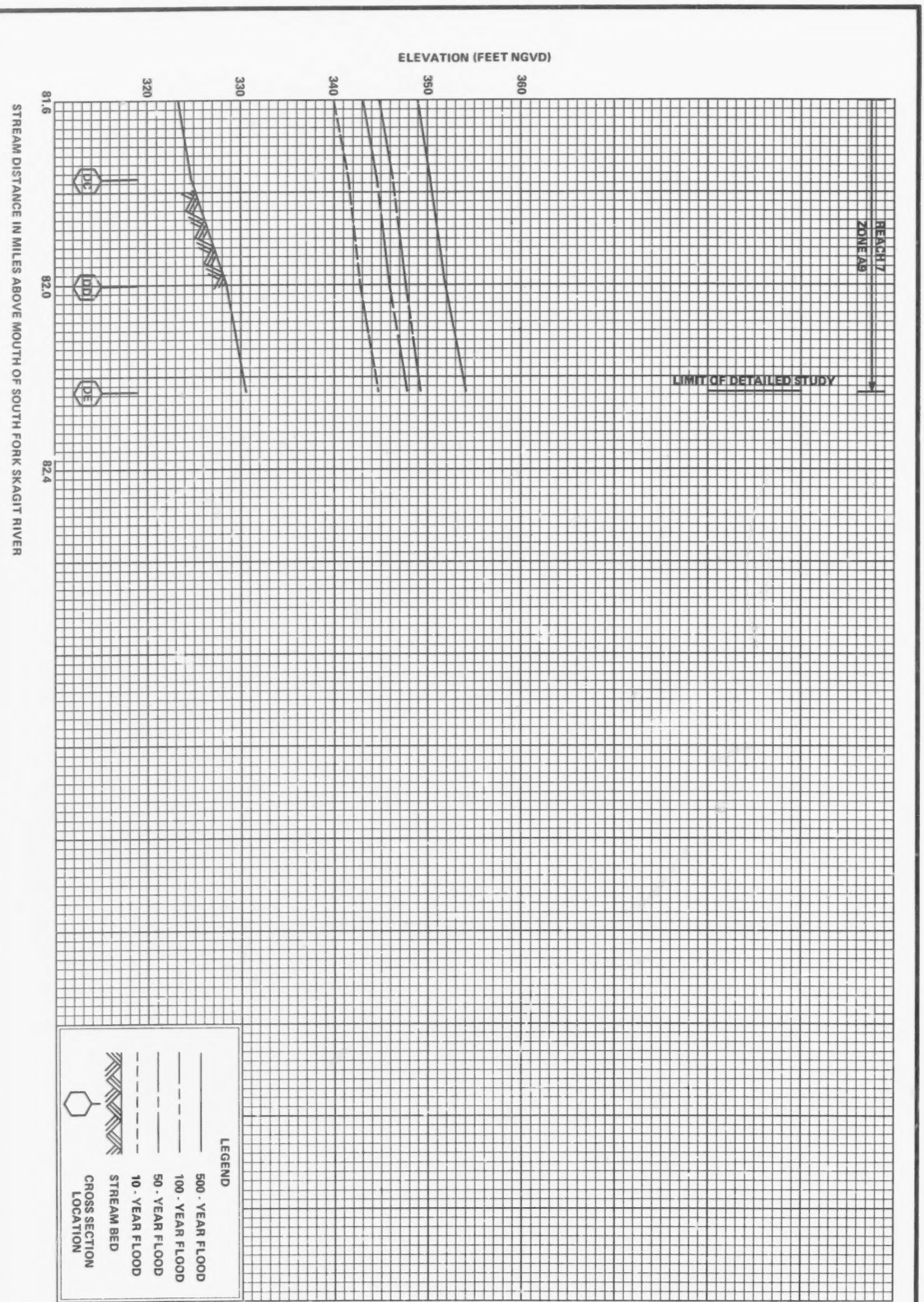
34P	FEDERAL EMERGENCY MANAGEMENT AGENCY SKAGIT COUNTY, WA (UNINCORPORATED AREAS)	FLOOD PROFILES SKAGIT RIVER



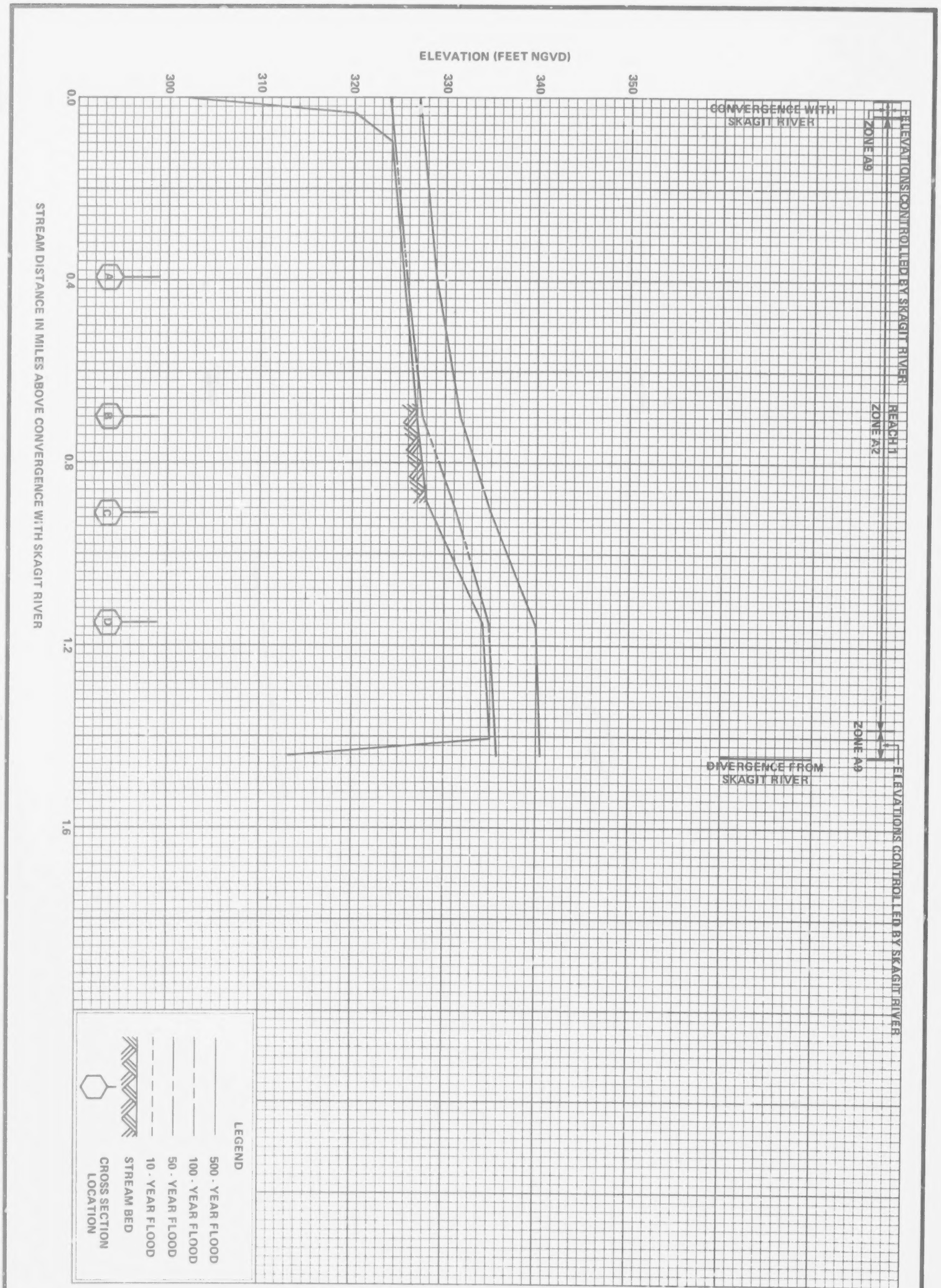
35P	FEDERAL EMERGENCY MANAGEMENT AGENCY SKAGIT COUNTY, WA (UNINCORPORATED AREAS)	FLOOD PROFILES SKAGIT RIVER



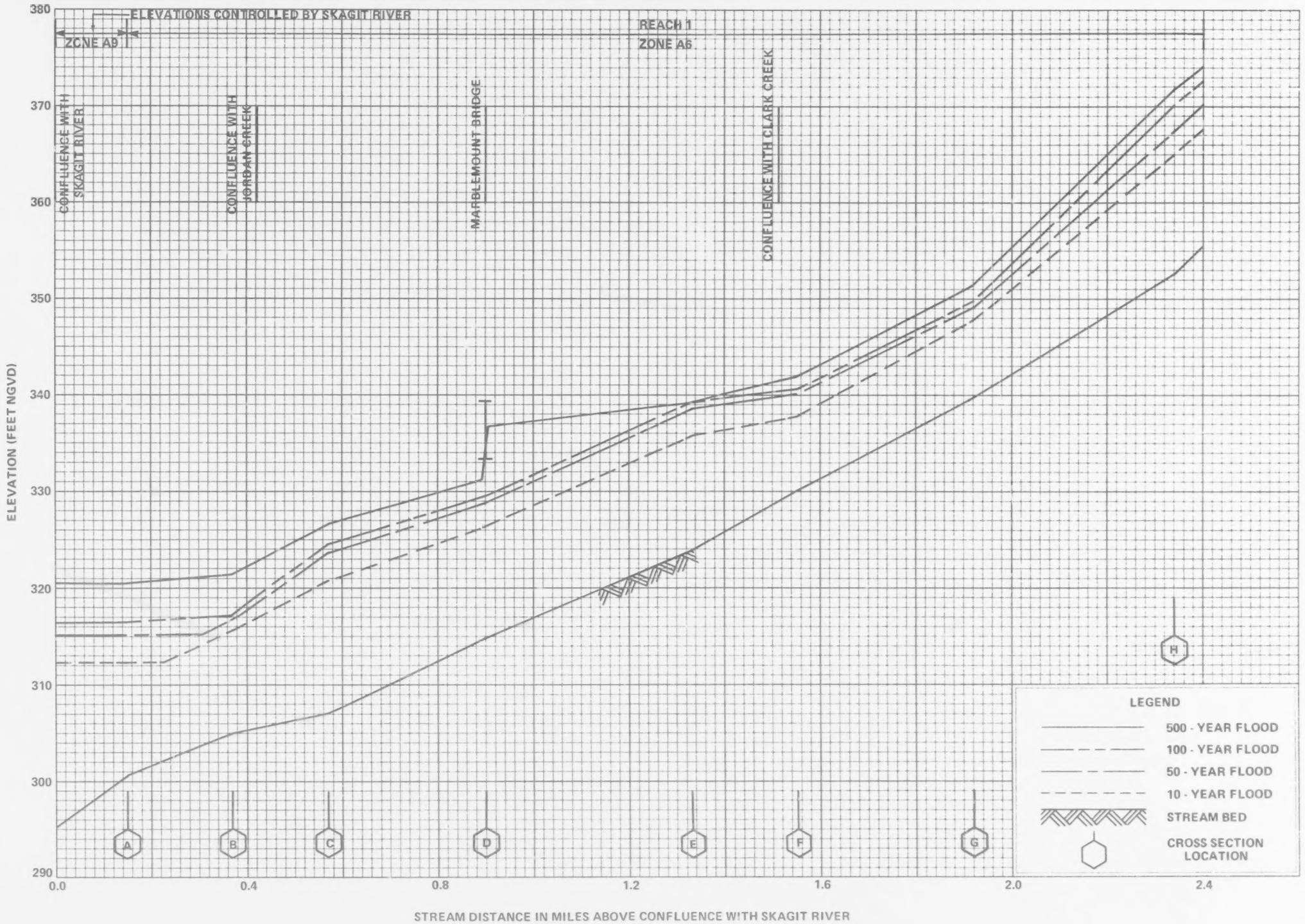
36P	FEDERAL EMERGENCY MANAGEMENT AGENCY SKAGIT COUNTY, WA (UNINCORPORATED AREAS)	FLOOD PROFILES SKAGIT RIVER



37P	FEDERAL EMERGENCY MANAGEMENT AGENCY SKAGIT COUNTY, WA (UNINCORPORATED AREAS)	FLOOD PROFILES SKAGIT RIVER



38P	FEDERAL EMERGENCY MANAGEMENT AGENCY SKAGIT COUNTY, WA (UNINCORPORATED AREAS)	**FLOOD PROFILES** SKAGIT RIVER SPLIT FLOW



FLOOD PROFILES

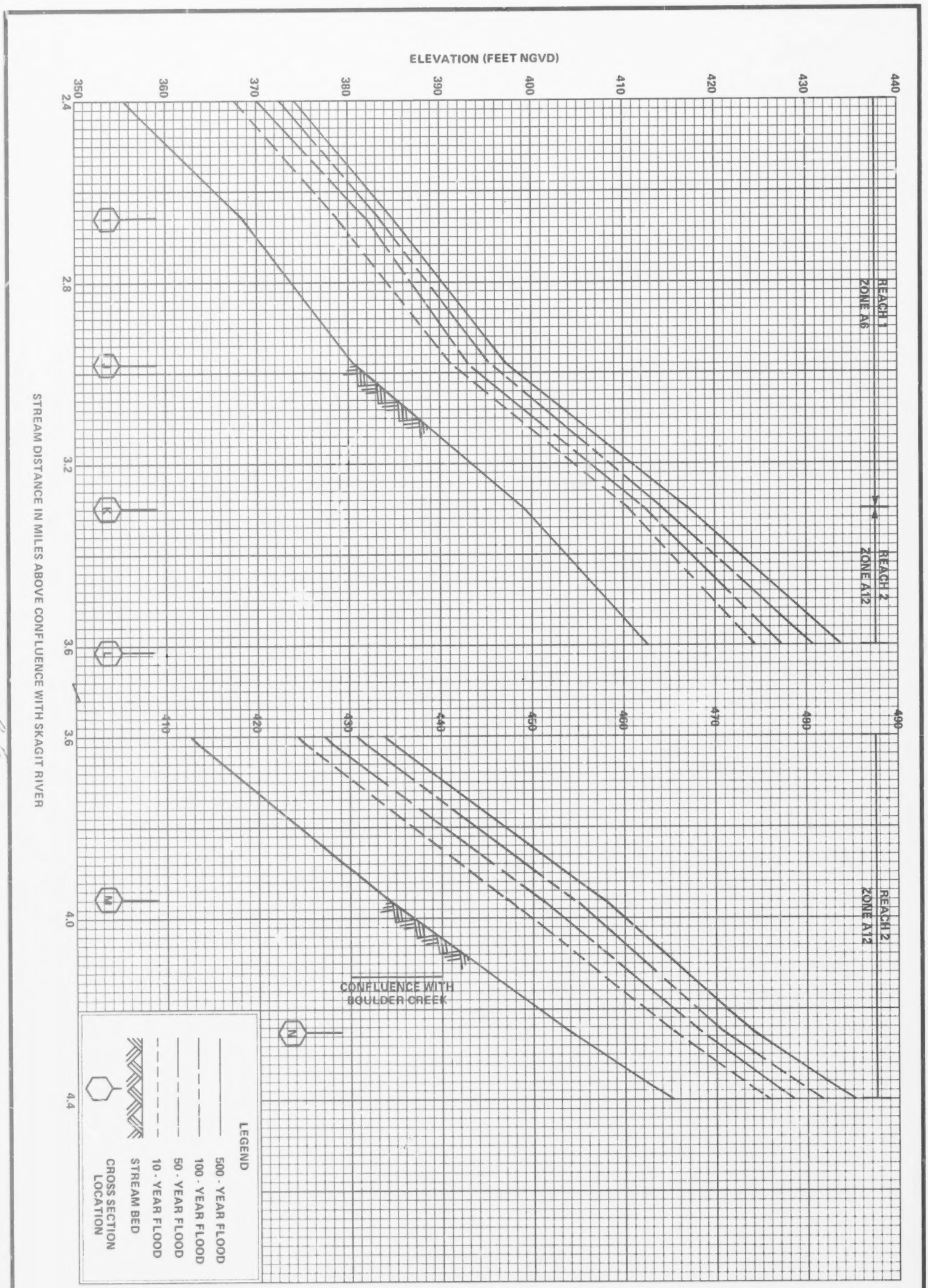
CASCADE RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

SKAGIT COUNTY, WA
(UNINCORPORATED AREAS)

39P

97

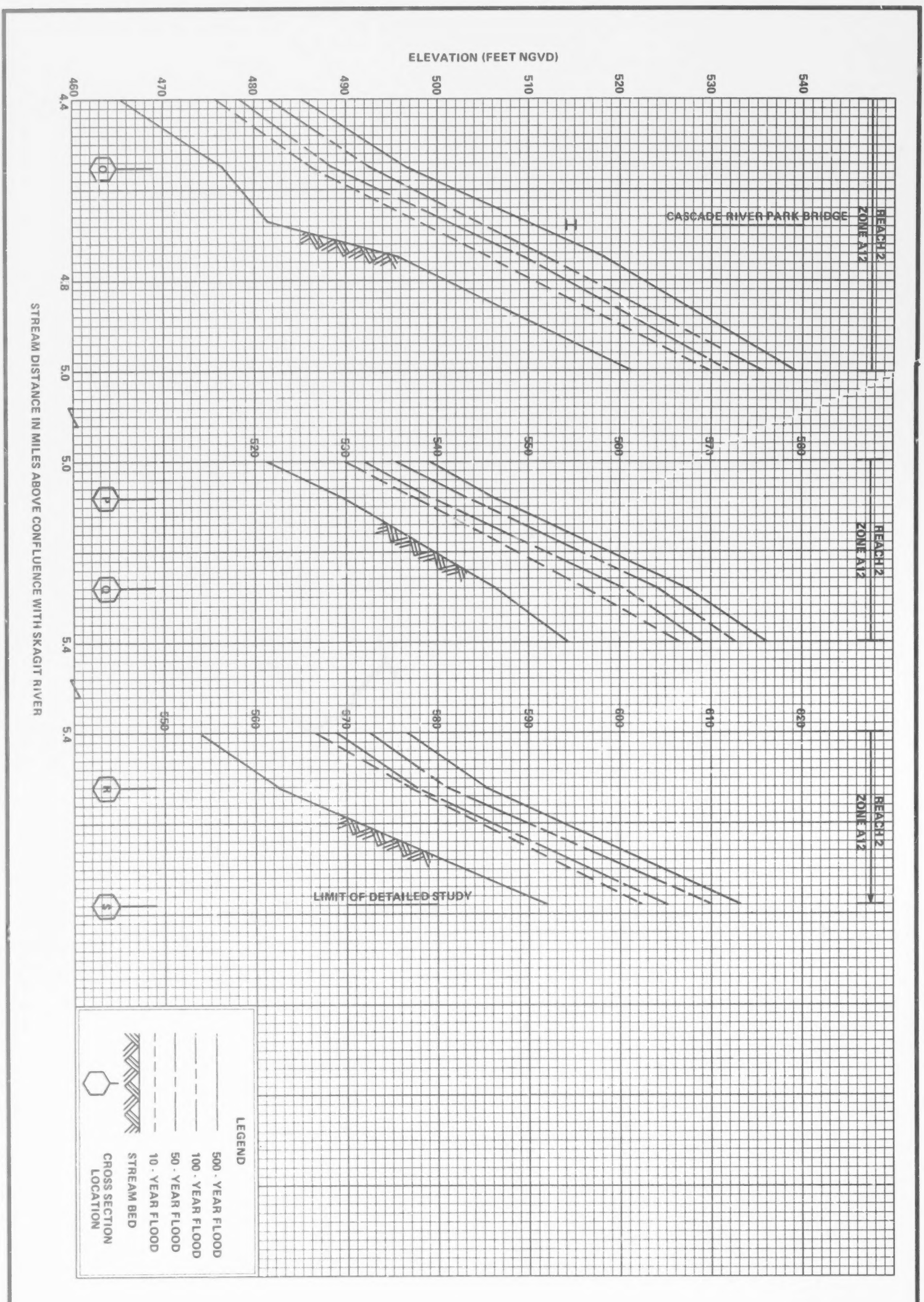


FEDERAL EMERGENCY MANAGEMENT AGENCY

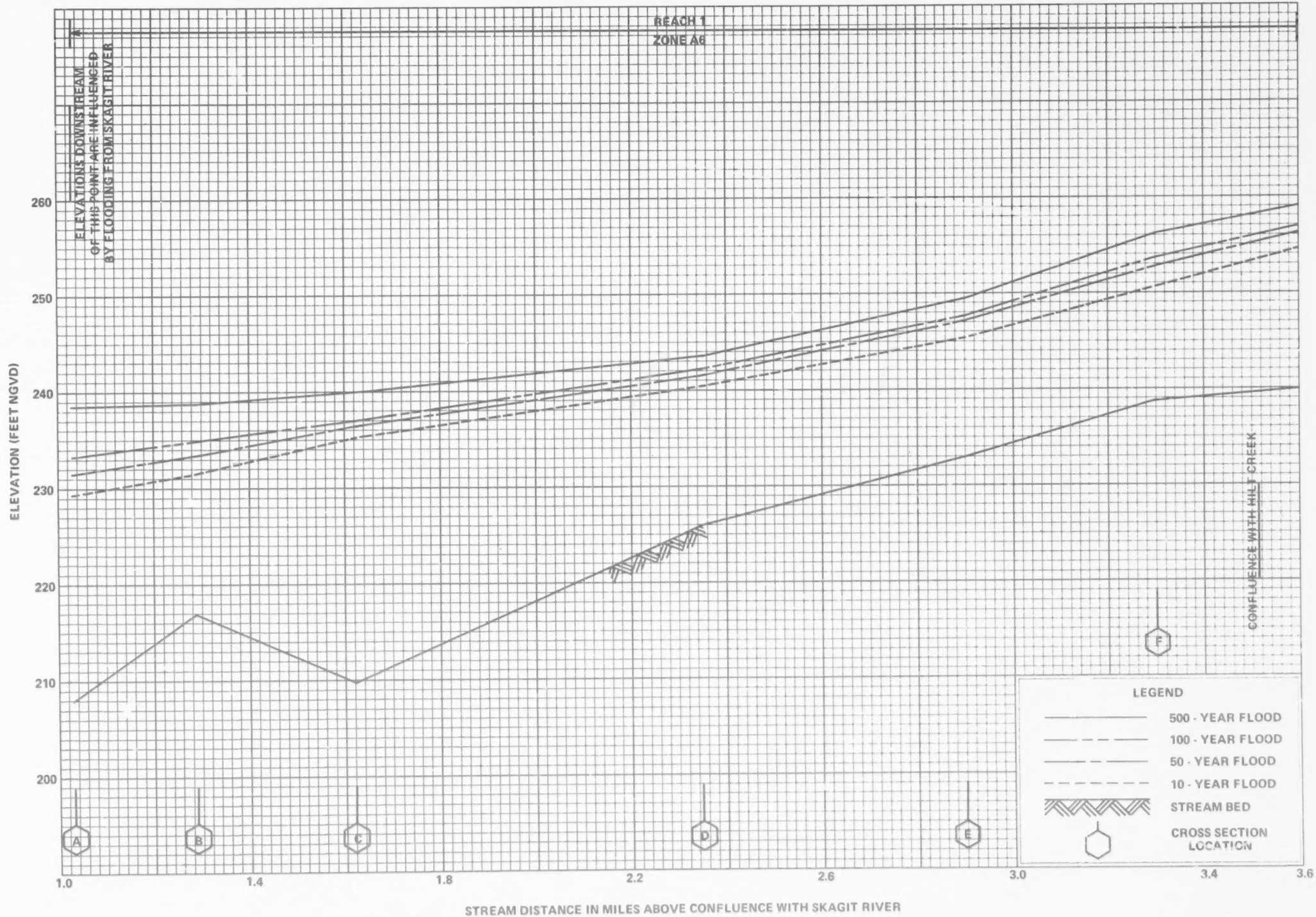
SKAGIT COUNTY, WA
(UNINCORPORATED AREAS)

FLOOD PROFILES

CASCADE RIVER



41P	FEDERAL EMERGENCY MANAGEMENT AGENCY SKAGIT COUNTY, WA (UNINCORPORATED AREAS)	FLOOD PROFILES CASCADE RIVER



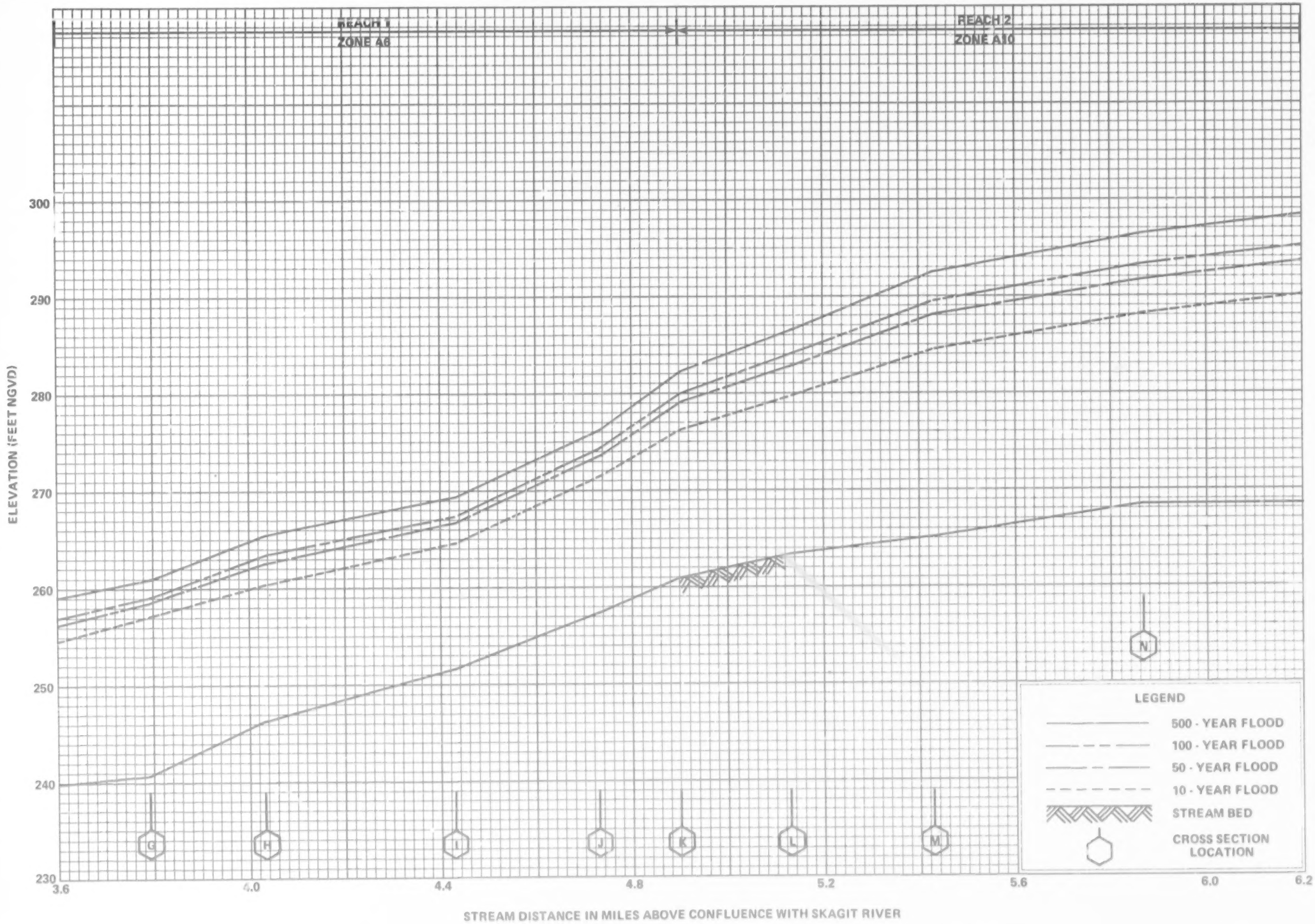
FLOOD PROFILES

SAUK RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

SKAGIT COUNTY, WA
(UNINCORPORATED AREAS)

42P



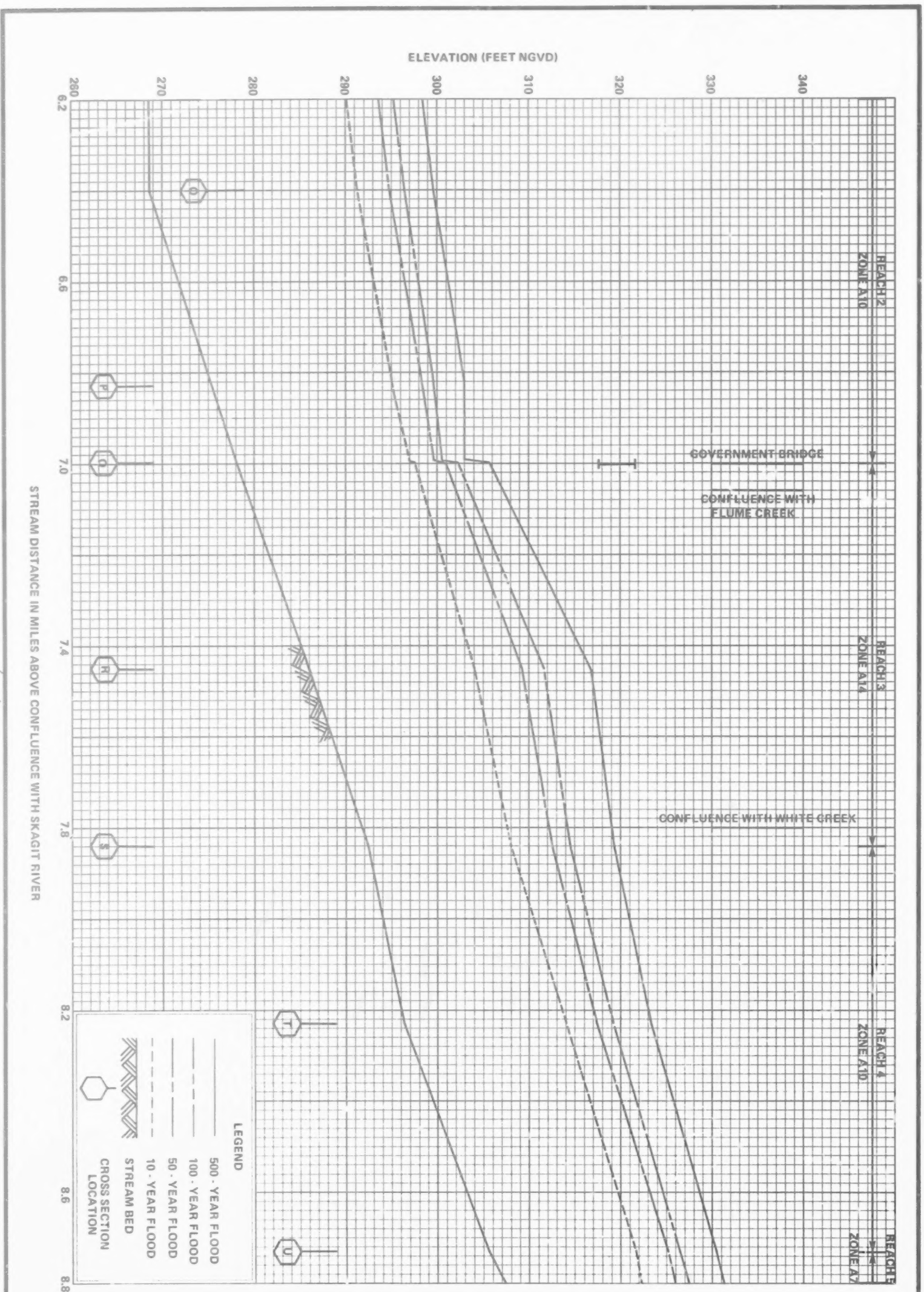
FLOOD PROFILES

SAUK RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

SKAGIT COUNTY, WA
(UNINCORPORATED AREAS)

43P



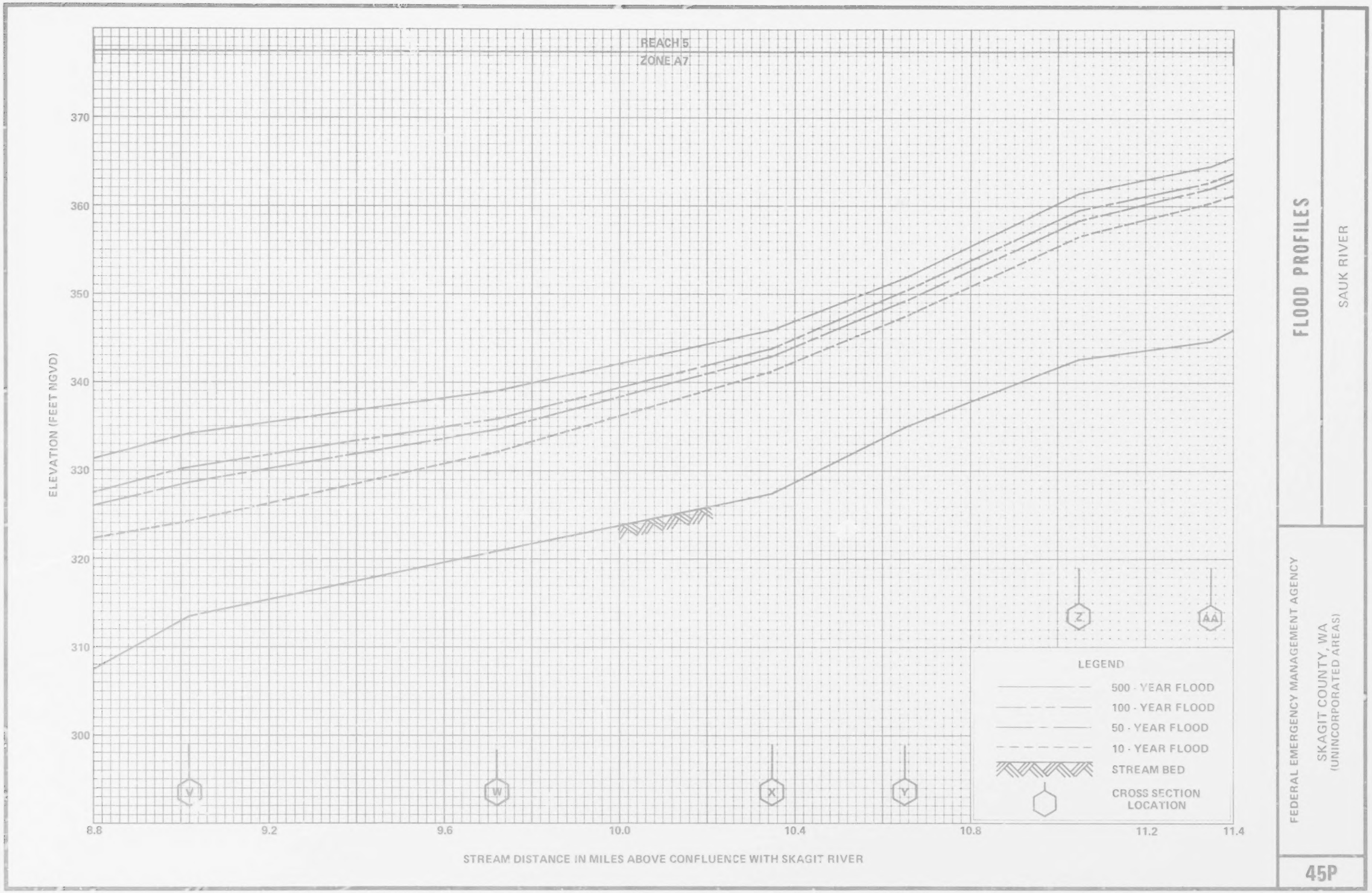
44P

FEDERAL EMERGENCY MANAGEMENT AGENCY

SKAGIT COUNTY, WA
(UNINCORPORATED AREAS)

FLOOD PROFILES

SAUK RIVER



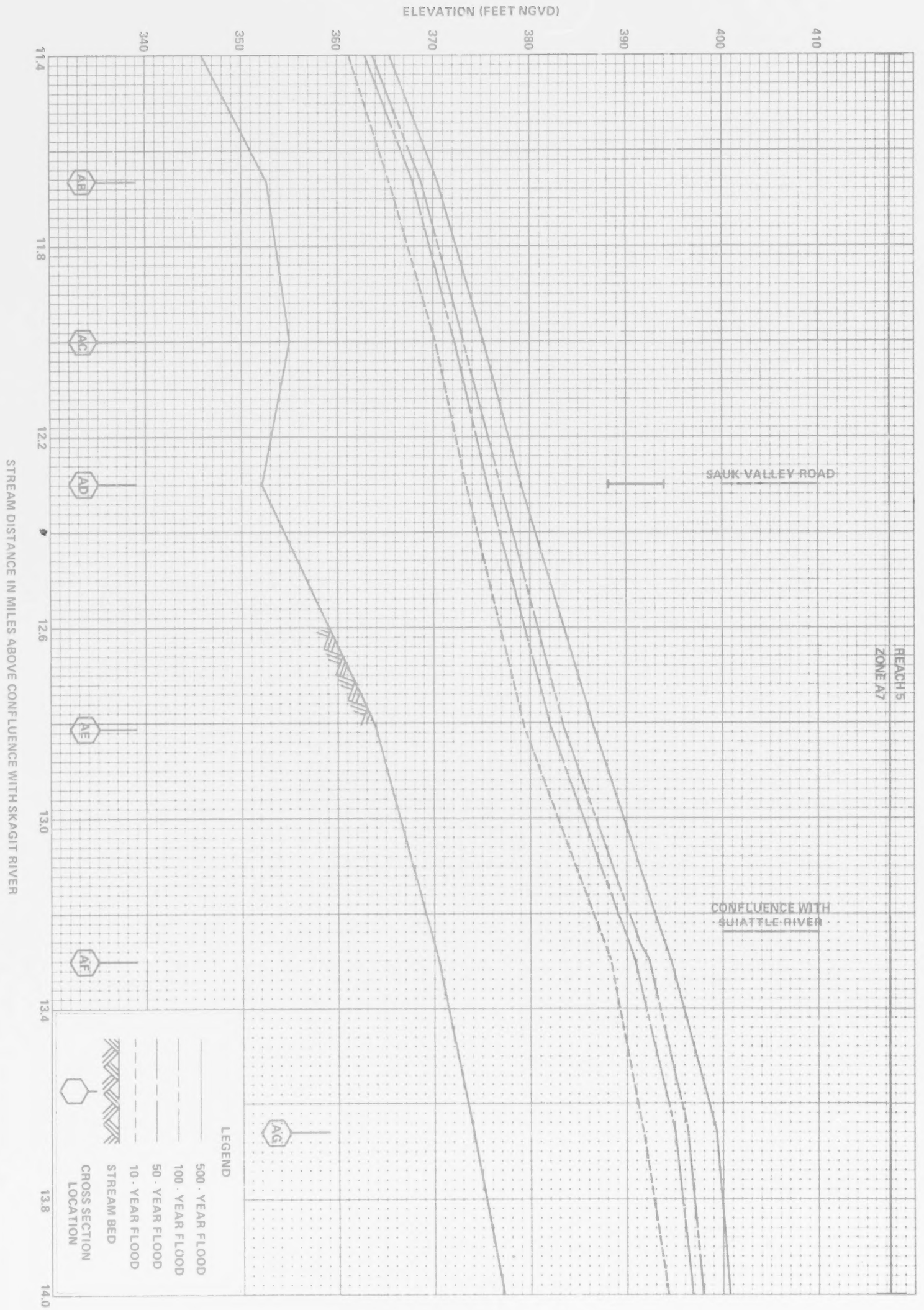
FLOOD PROFILES

SAUK RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

SKAGIT COUNTY, WA
(UNINCORPORATED AREAS)

45P



FEDERAL EMERGENCY MANAGEMENT AGENCY

SKAGIT COUNTY, WA
(UNINCORPORATED AREAS)

FLOOD PROFILES

SAUK RIVER

REACH 5
ZONE A7

ELEVATION (FEET NGVD)

430
420
410
400
390
380
370

14.0
14.4
14.8
15.2
15.6
16.0
16.4

AH
AI
AJ
AK
AL

LEGEND
500 - YEAR FLOOD
100 - YEAR FLOOD
50 - YEAR FLOOD
10 - YEAR FLOOD
STREAM BED
CROSS SECTION LOCATION

STREAM DISTANCE IN MILES ABOVE CONFLUENCE WITH SKAGIT RIVER

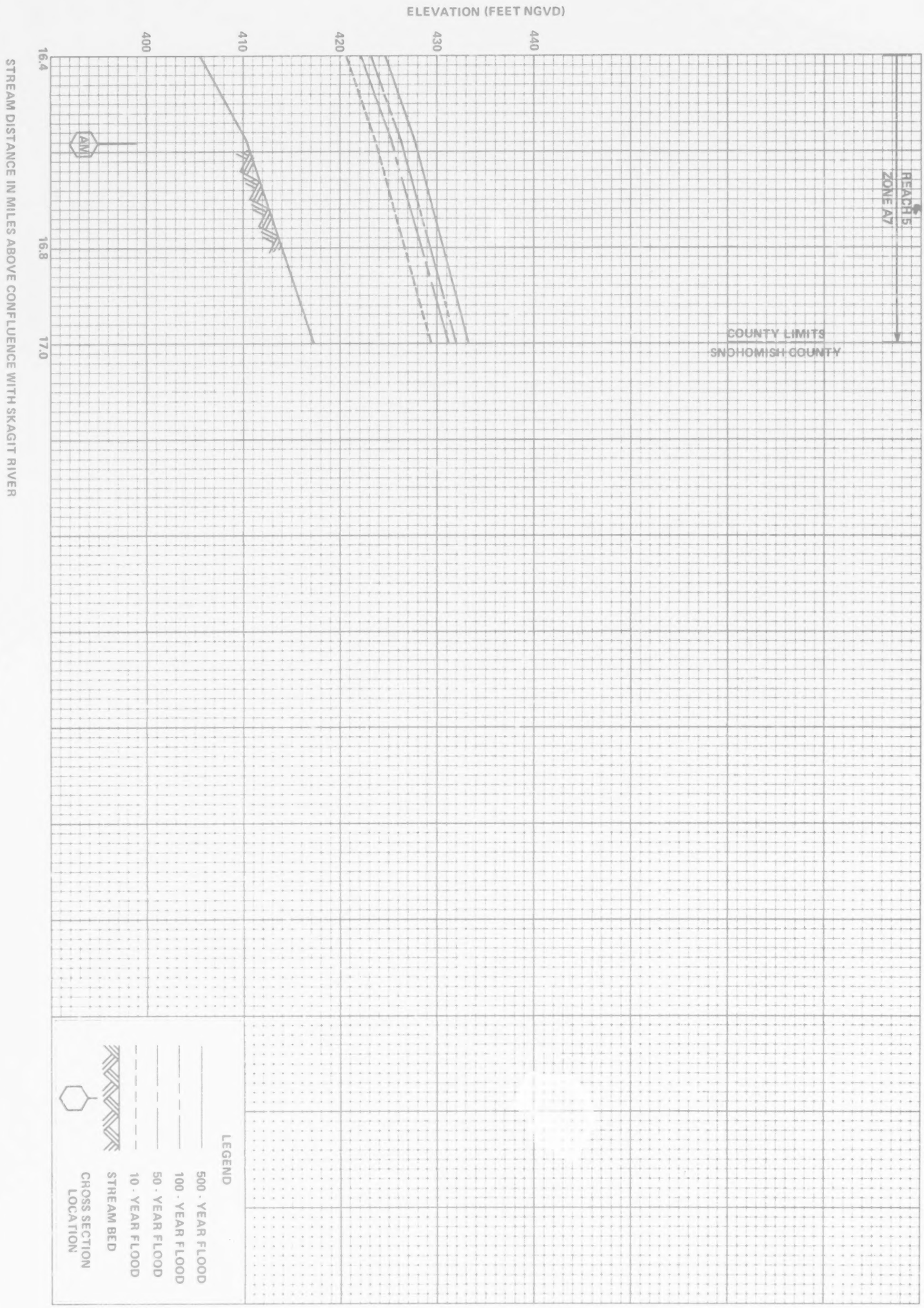
FLOOD PROFILES

SAUK RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

SKAGIT COUNTY, WA
(UNINCORPORATED AREAS)

47P

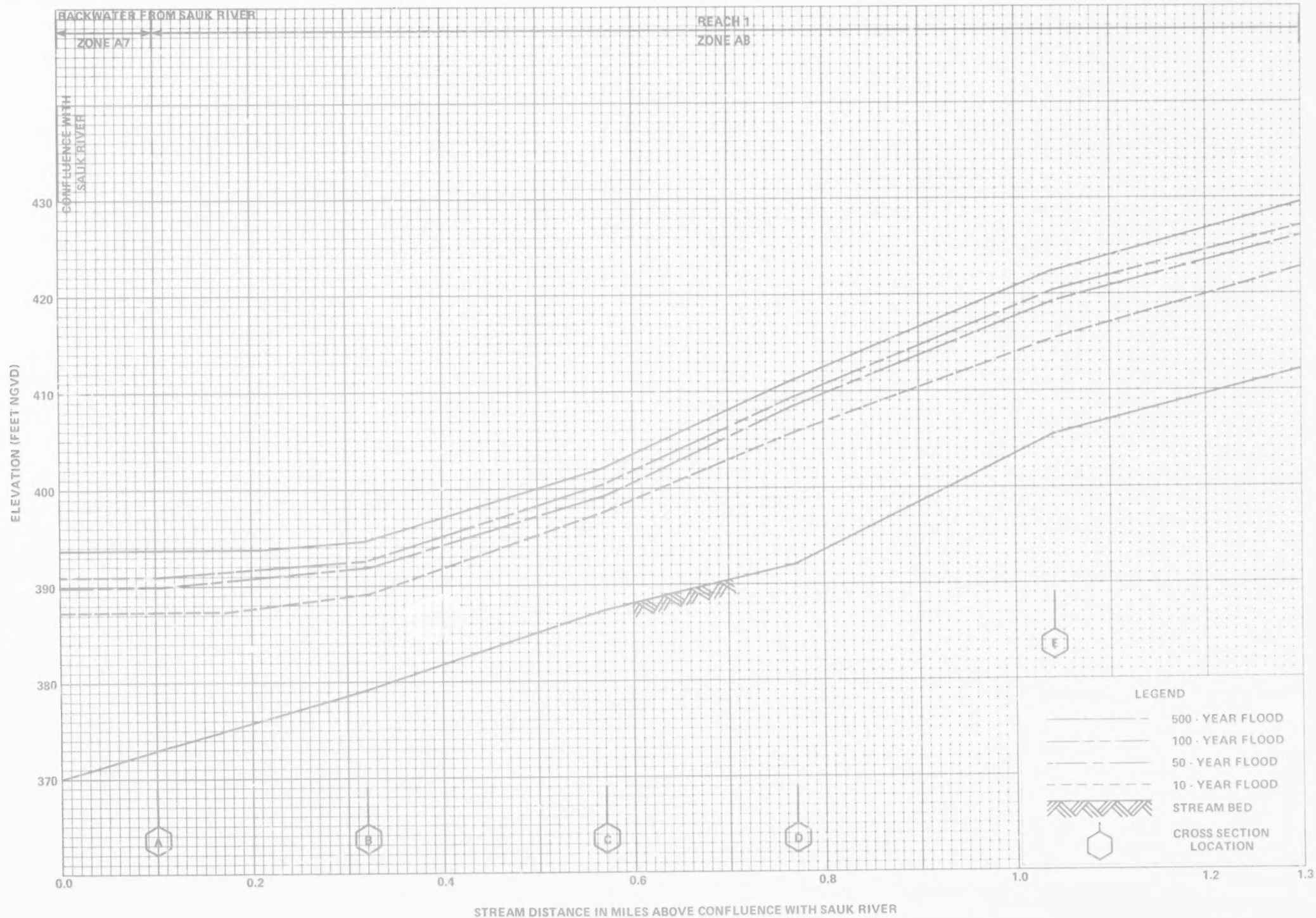


FEDERAL EMERGENCY MANAGEMENT AGENCY

SKAGIT COUNTY, WA
(UNINCORPORATED AREAS)

FLOOD PROFILES

SAUK RIVER

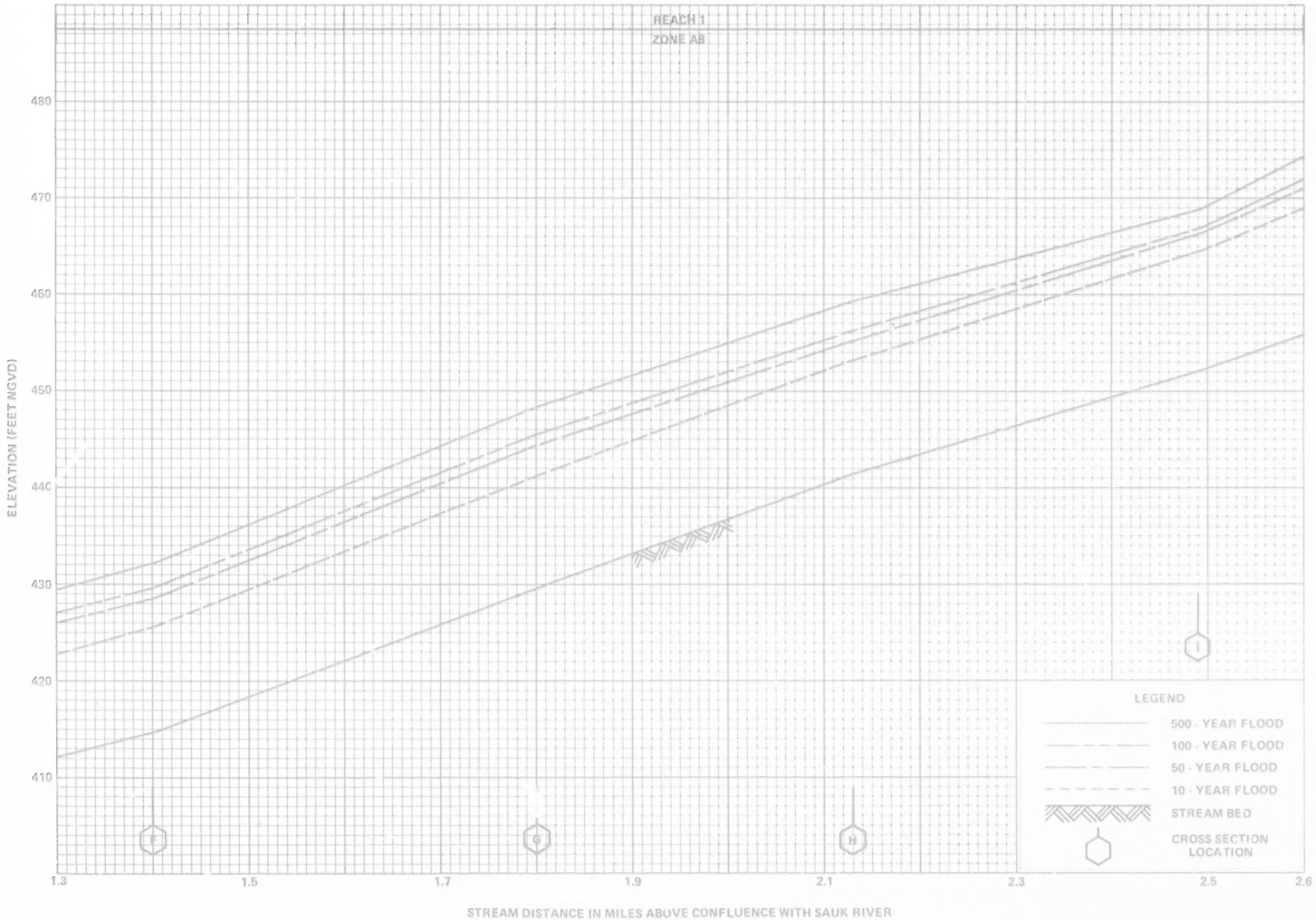


FLOOD PROFILES

SUIATTLE RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

SKAGIT COUNTY, WA
(UNINCORPORATED AREAS)



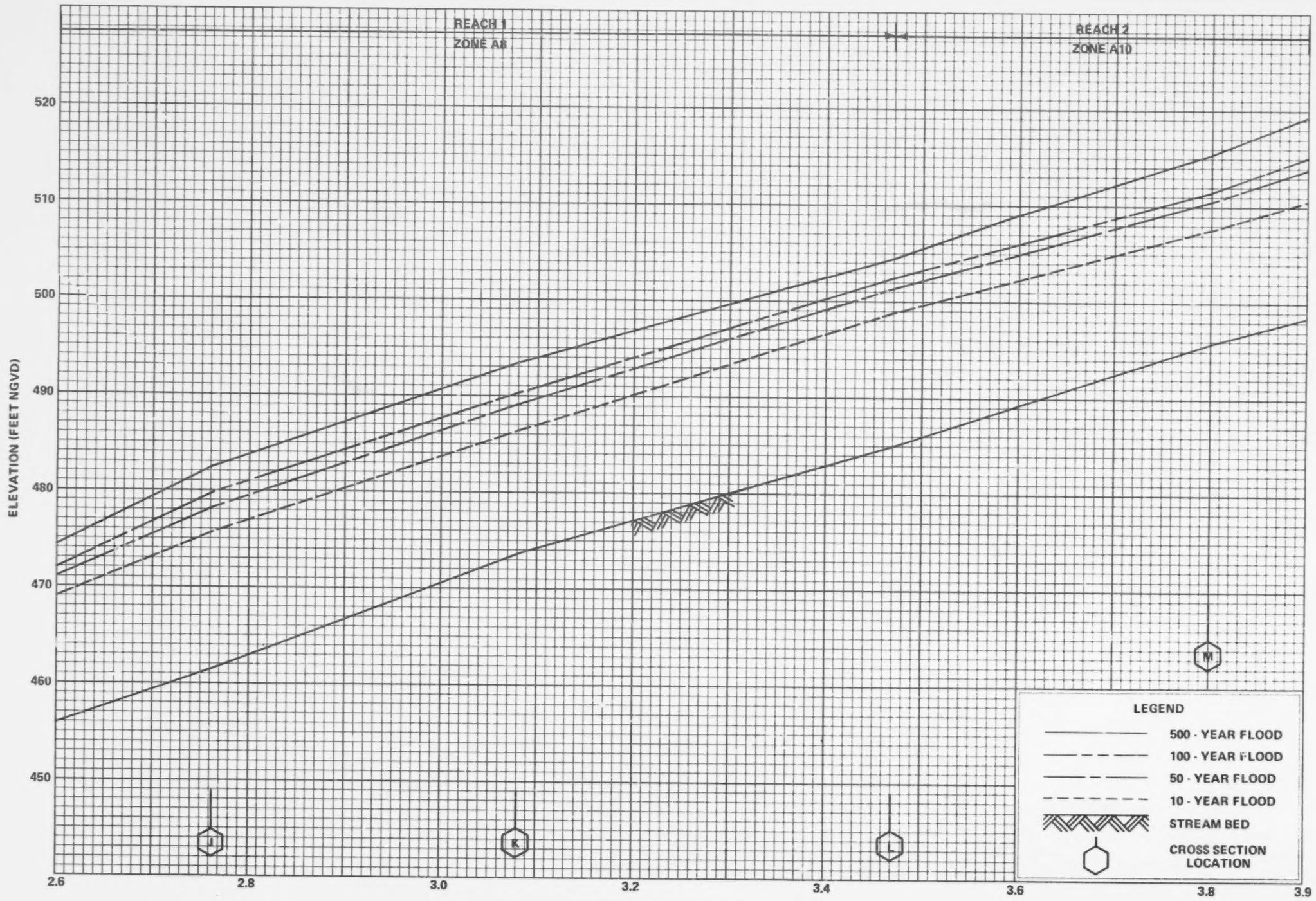
FLOOD PROFILES

SUIATTLE RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

SKAGIT COUNTY, WA
(UNINCORPORATED AREAS)

50P



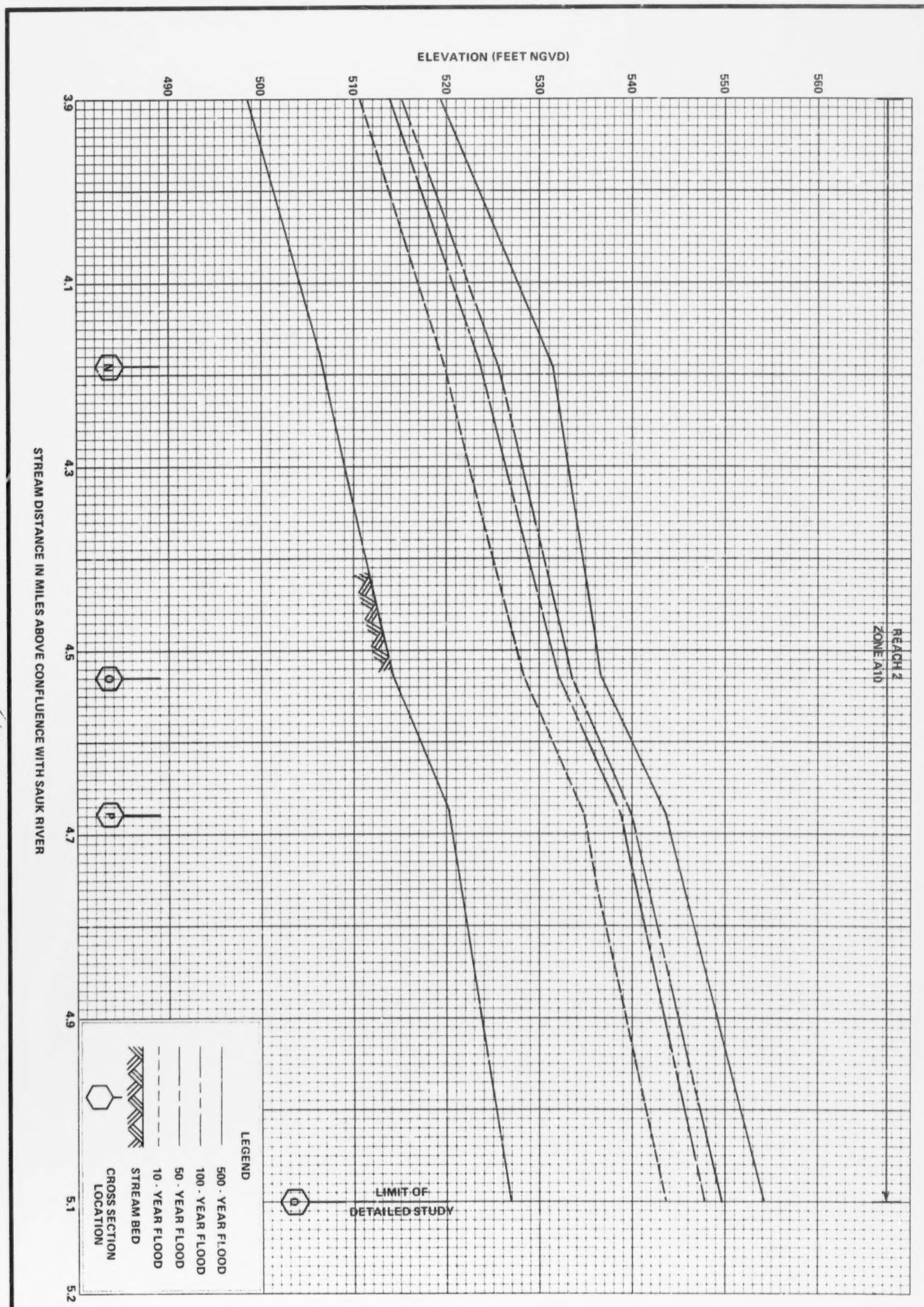
FLOOD PROFILES

SUIATTLE RIVER

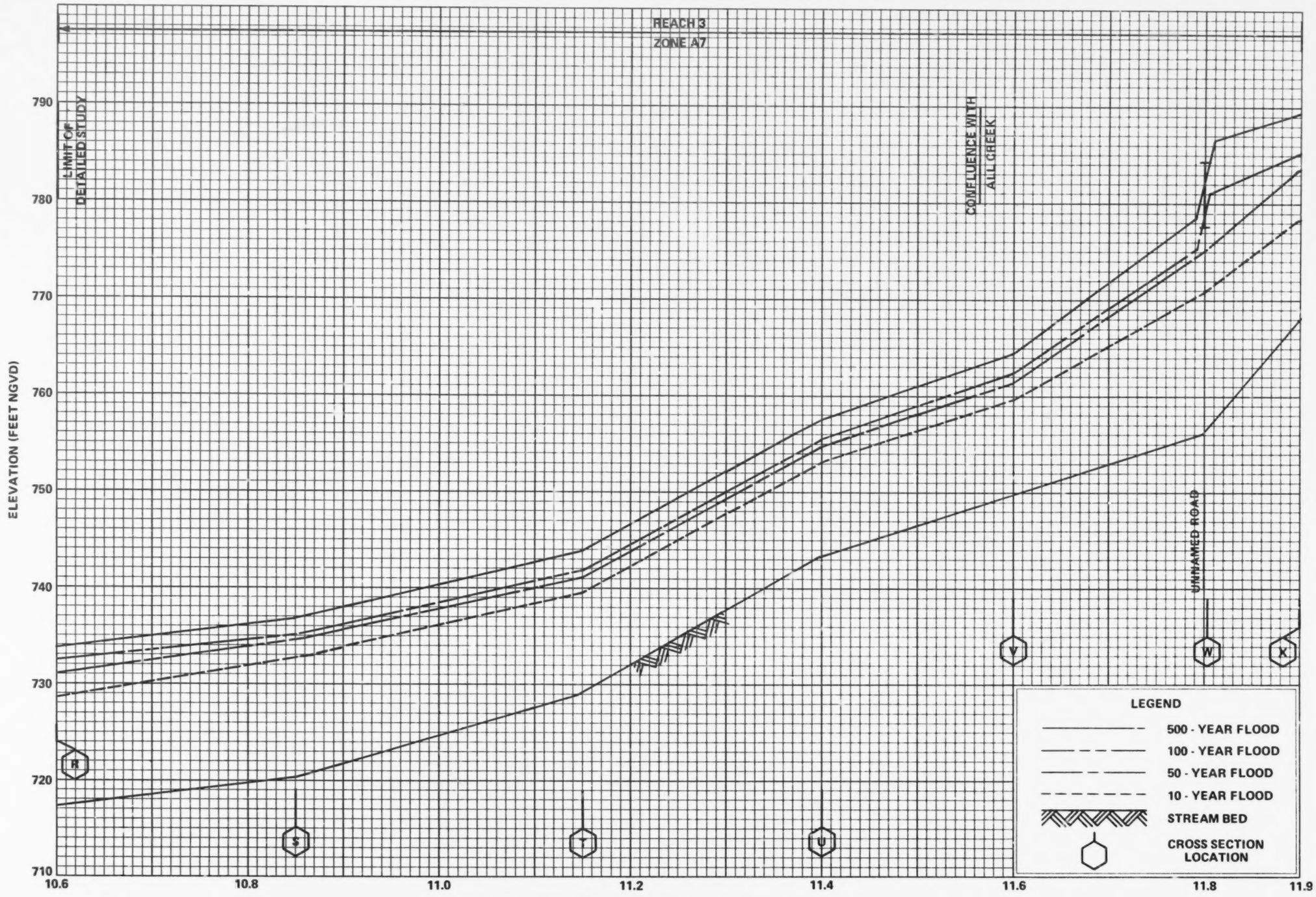
FEDERAL EMERGENCY MANAGEMENT AGENCY

SKAGIT COUNTY, WA
(UNINCORPORATED AREAS)

51P



52P	FEDERAL EMERGENCY MANAGEMENT AGENCY SKAGIT COUNTY, WA (UNINCORPORATED AREAS)	FLOOD PROFILES SUIATTLE RIVER



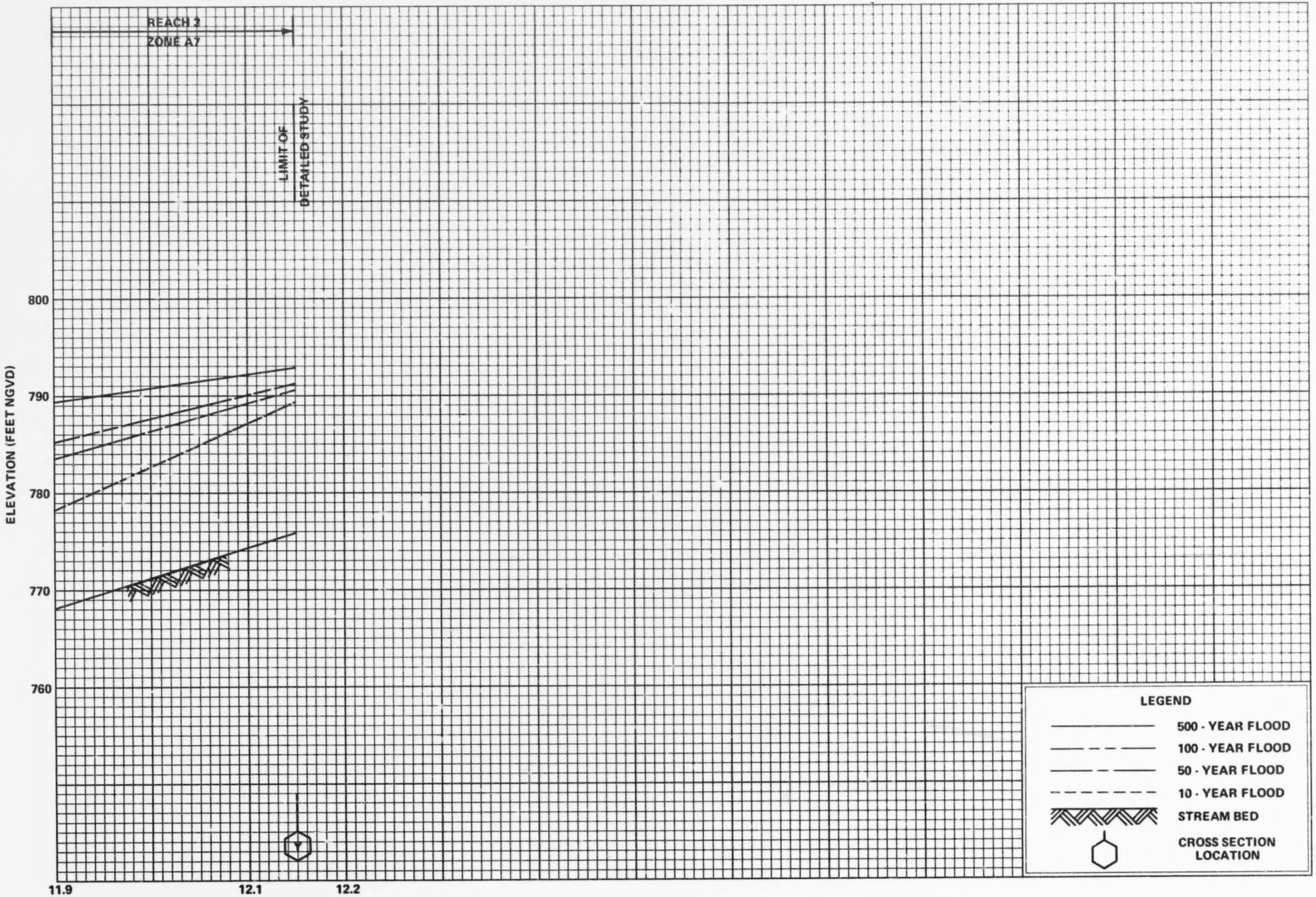
FLOOD PROFILES

SUIATTLE RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

SKAGIT COUNTY, WA
(UNINCORPORATED AREAS)

53P



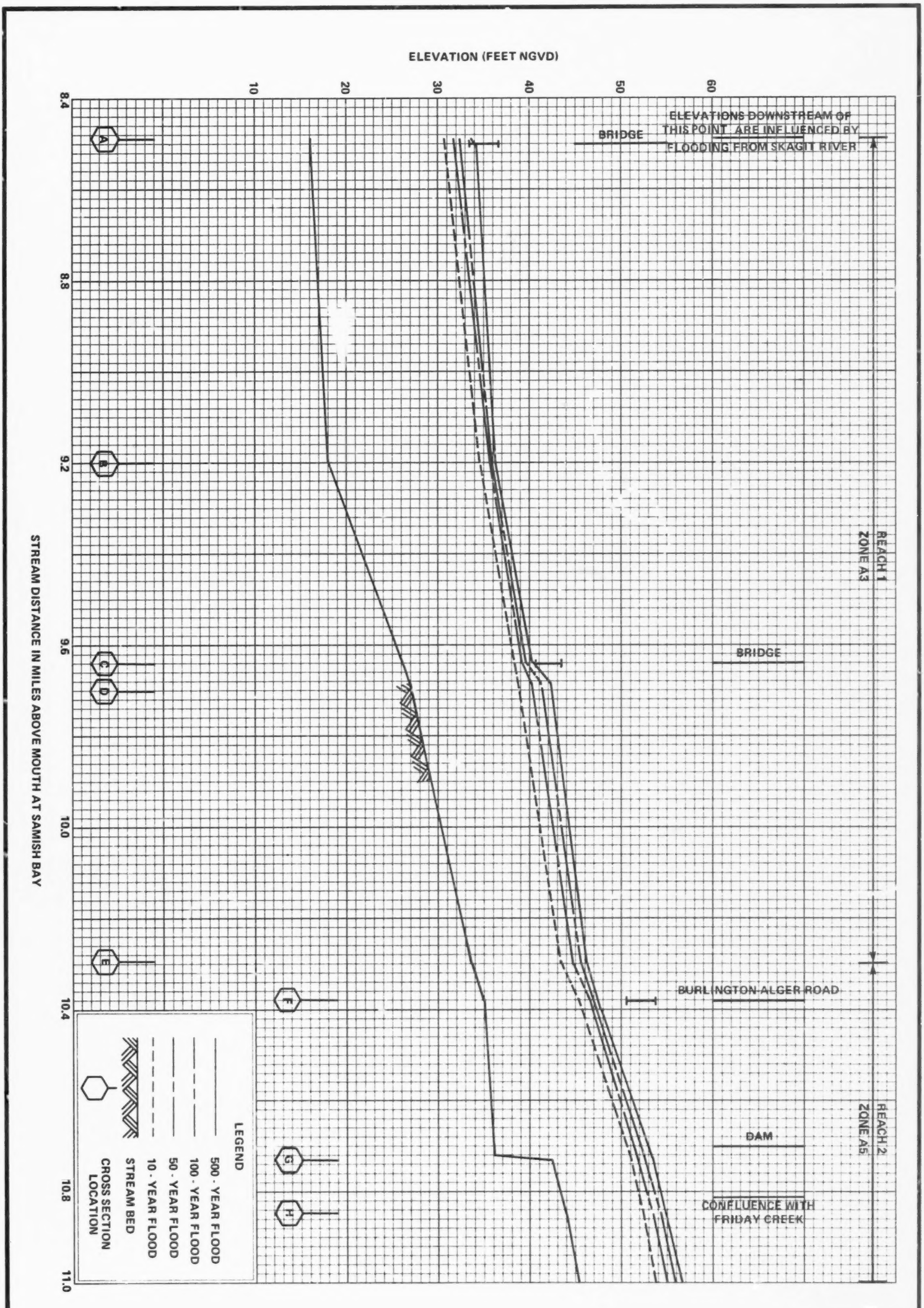
FLOOD PROFILES

SUIATTLE RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

SKAGIT COUNTY, WA
(UNINCORPORATED AREAS)

54P



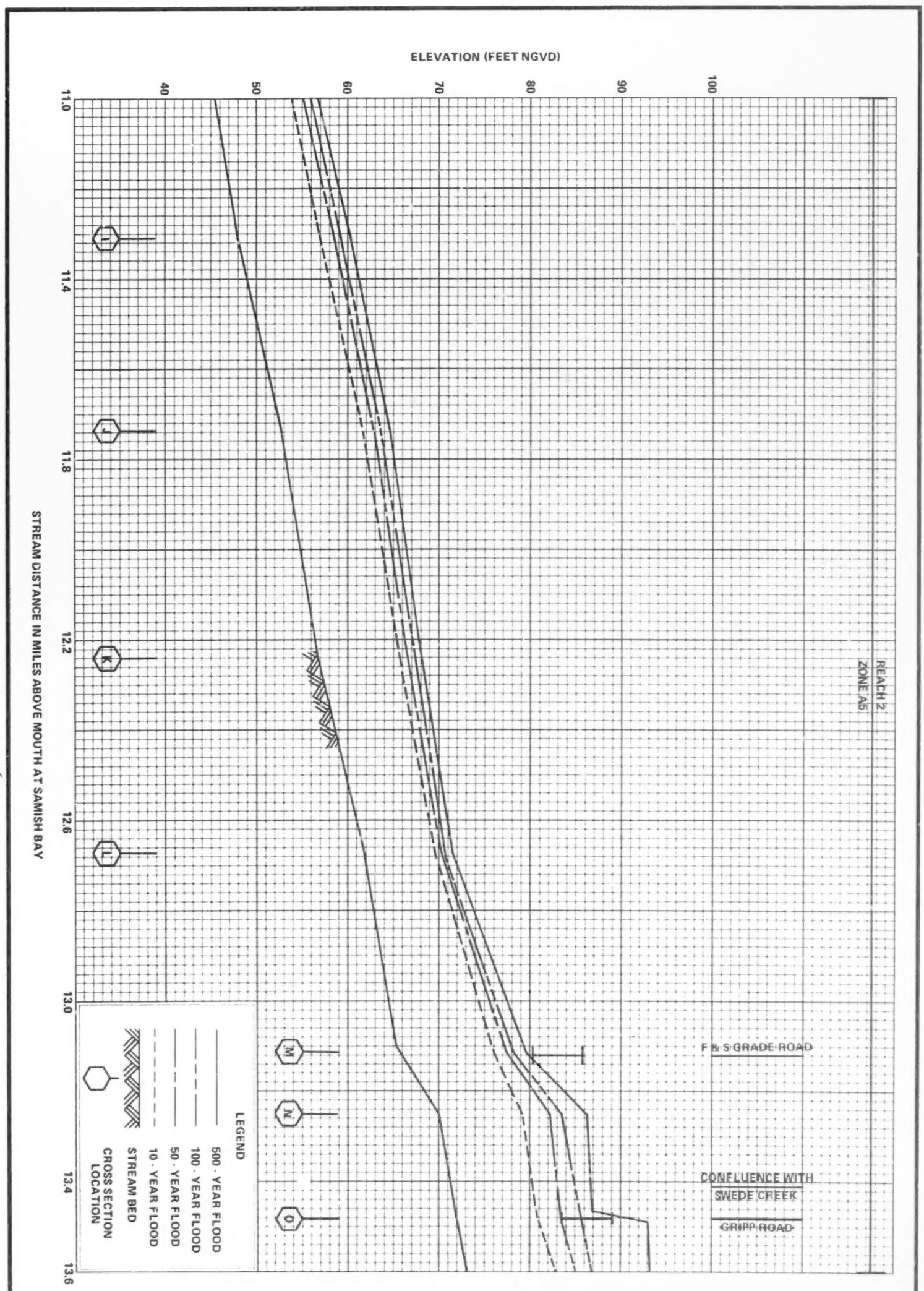
55P

FEDERAL EMERGENCY MANAGEMENT AGENCY

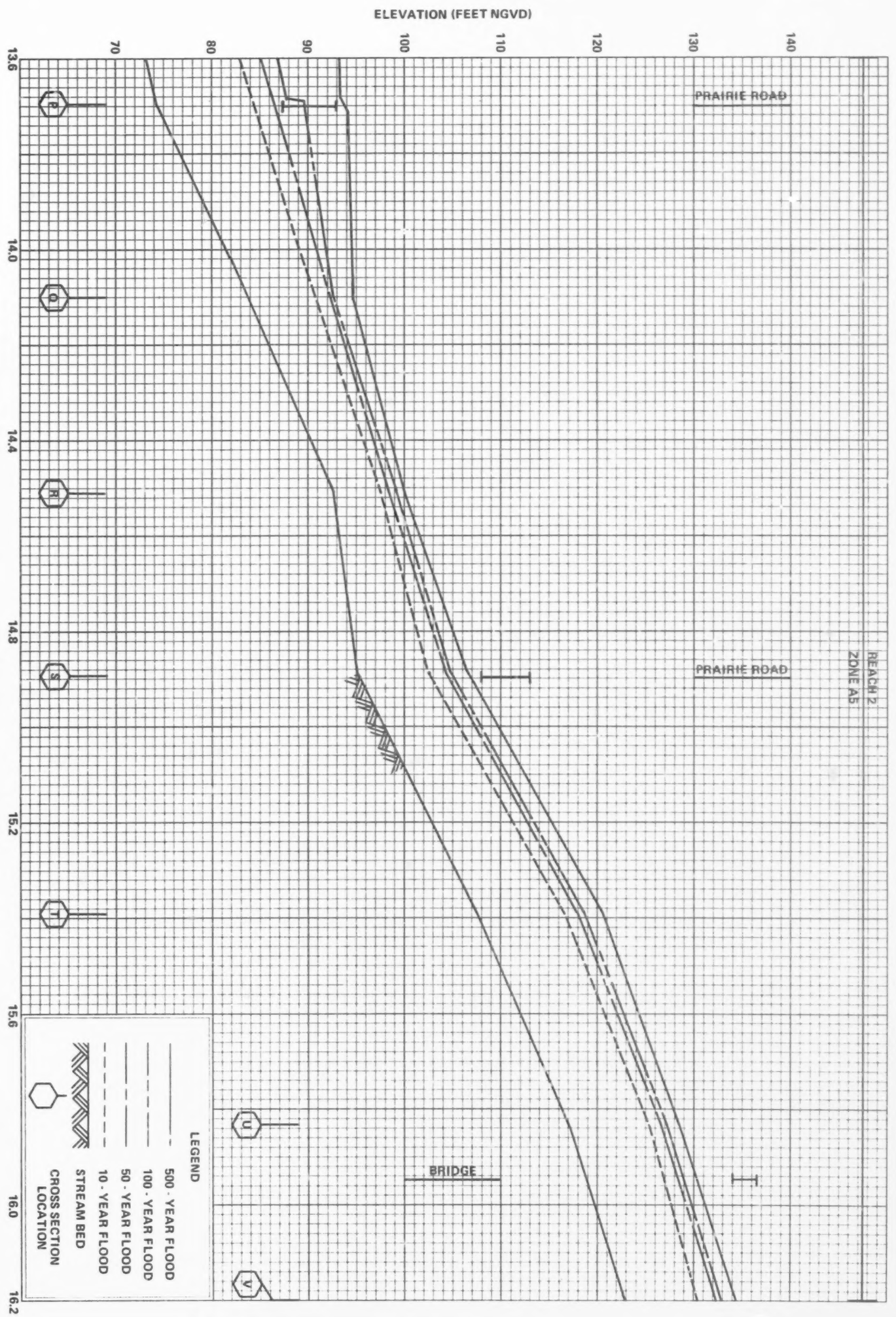
SKAGIT COUNTY, WA
(UNINCORPORATED AREAS)

FLOOD PROFILES

SAMISH RIVER



56P	FEDERAL EMERGENCY MANAGEMENT AGENCY SKAGIT COUNTY, WA (UNINCORPORATED AREAS)	FLOOD PROFILES SAMISH RIVER

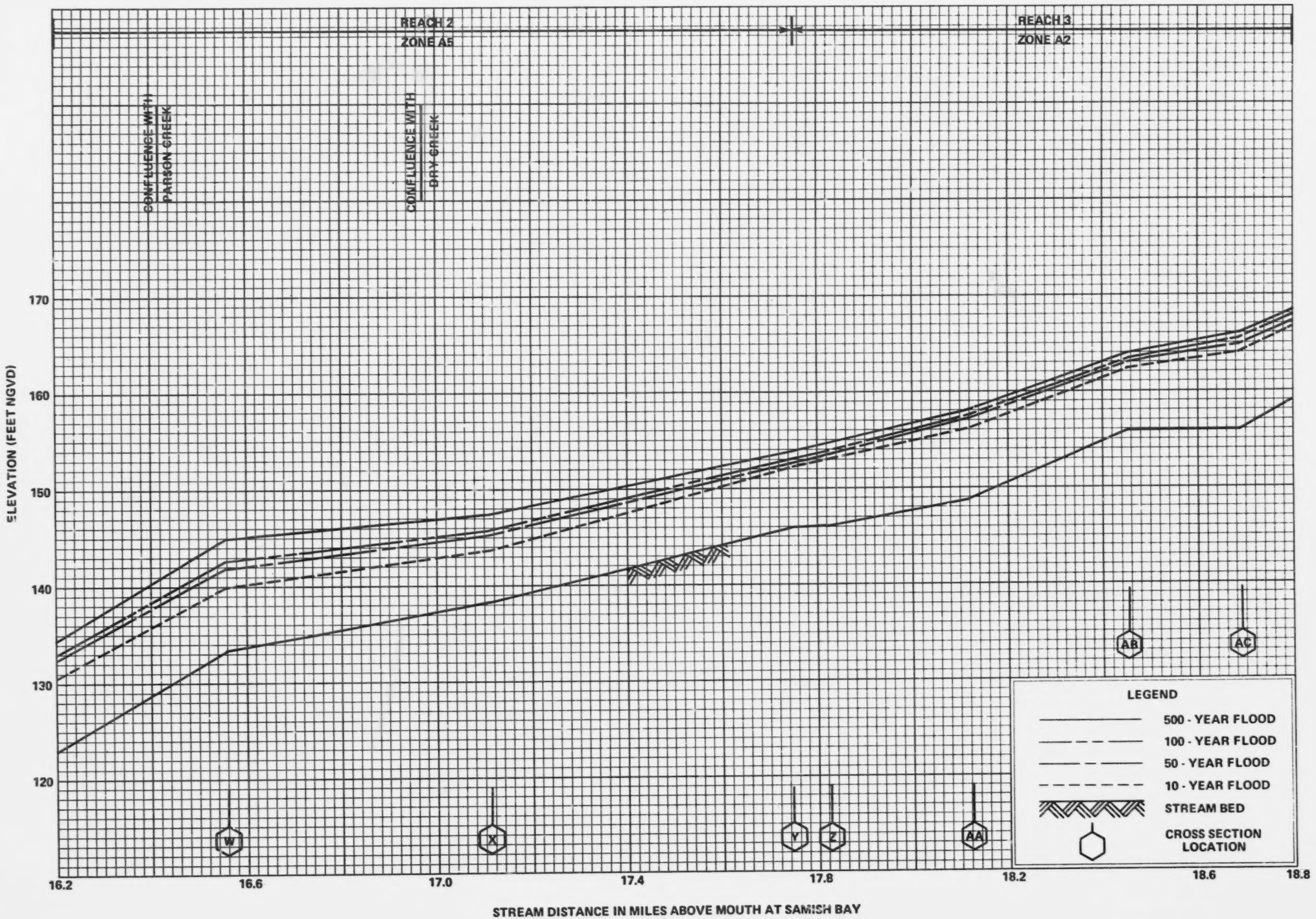


FEDERAL EMERGENCY MANAGEMENT AGENCY

SKAGIT COUNTY, WA
(UNINCORPORATED AREAS)

FLOOD PROFILES

SAMISH RIVER



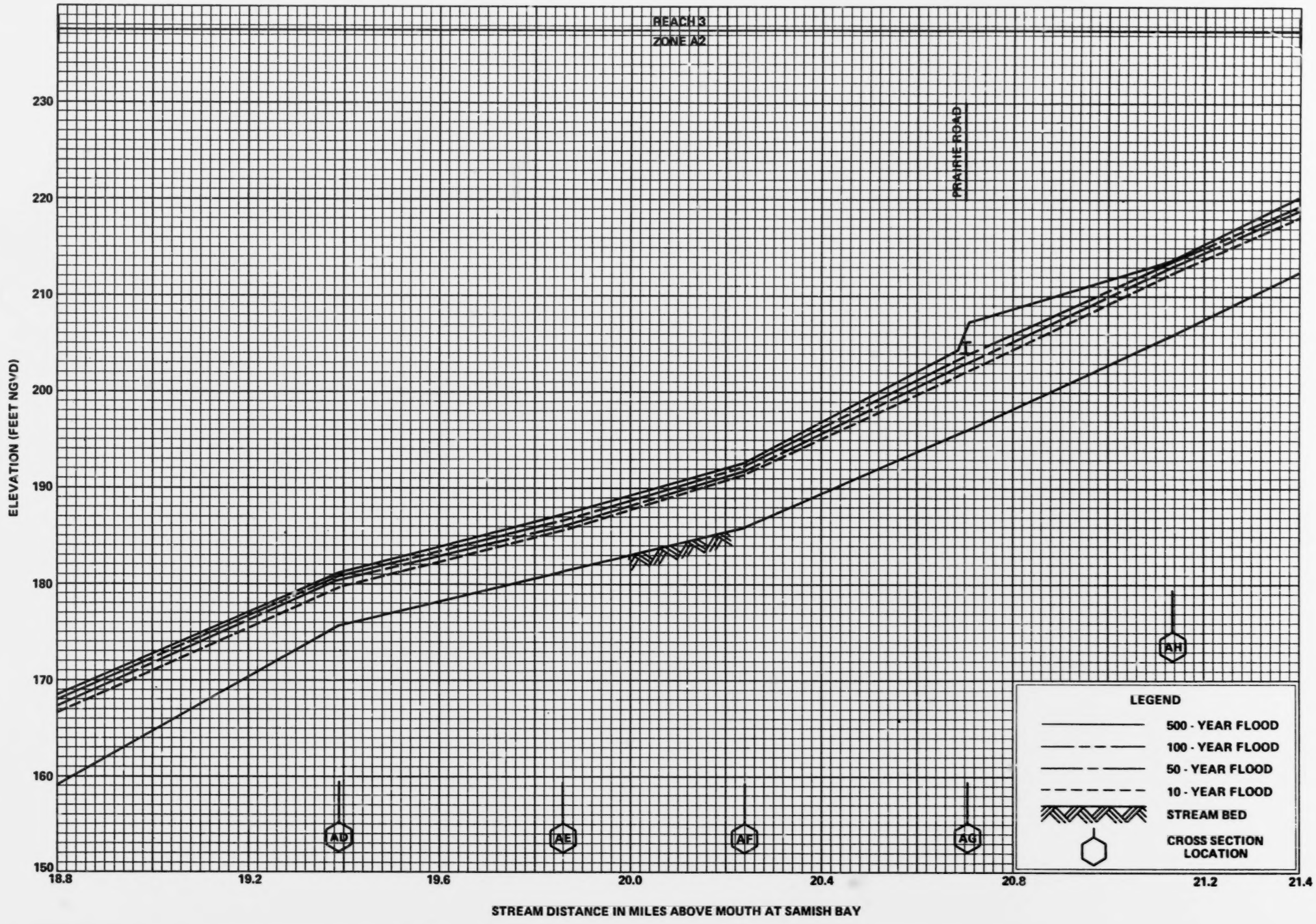
FLOOD PROFILES

SAMISH RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

SKAGIT COUNTY, WA
(UNINCORPORATED AREAS)

58P



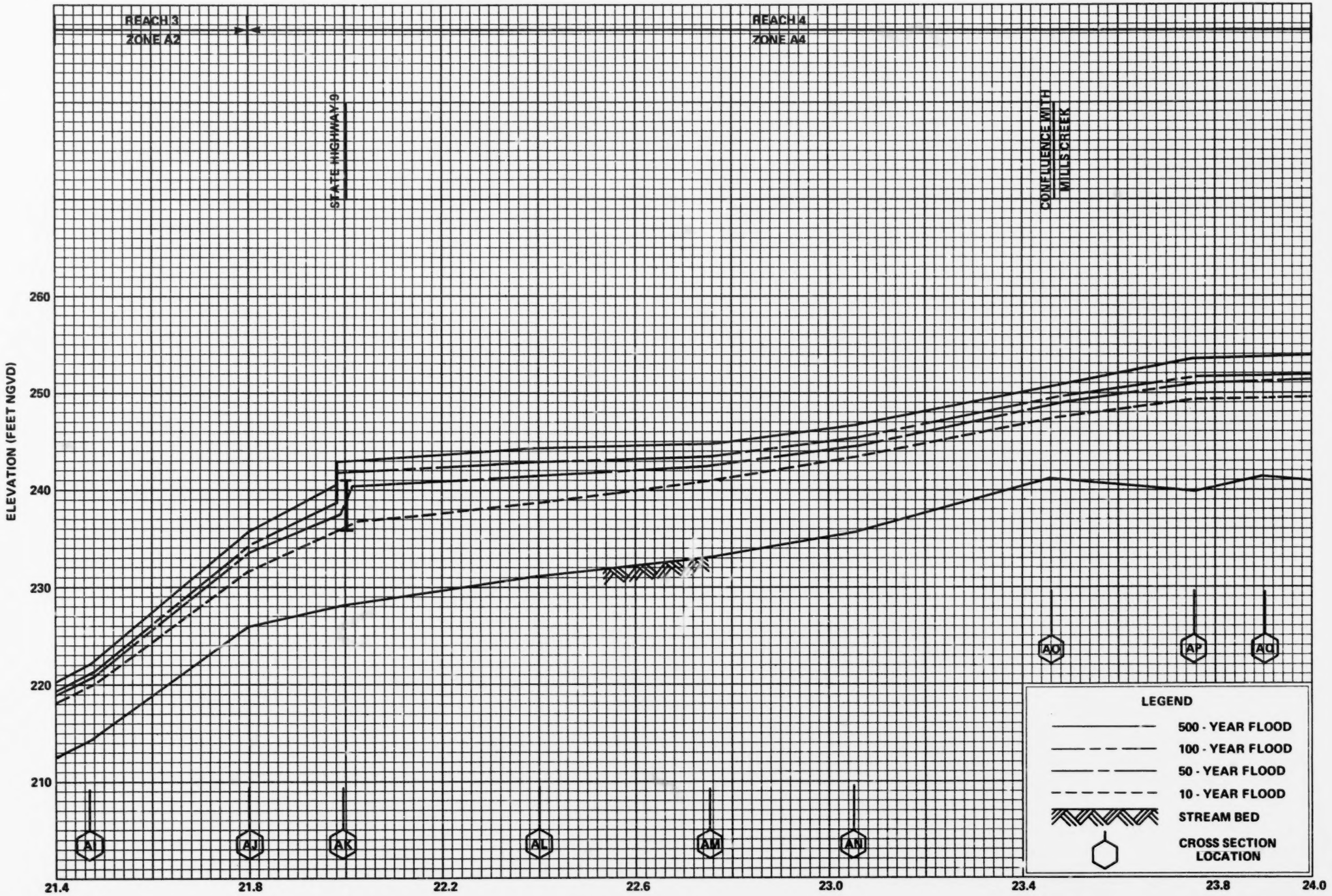
FLOOD PROFILES

SAMISH RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

SKAGIT COUNTY, WA
(UNINCORPORATED AREAS)

59P



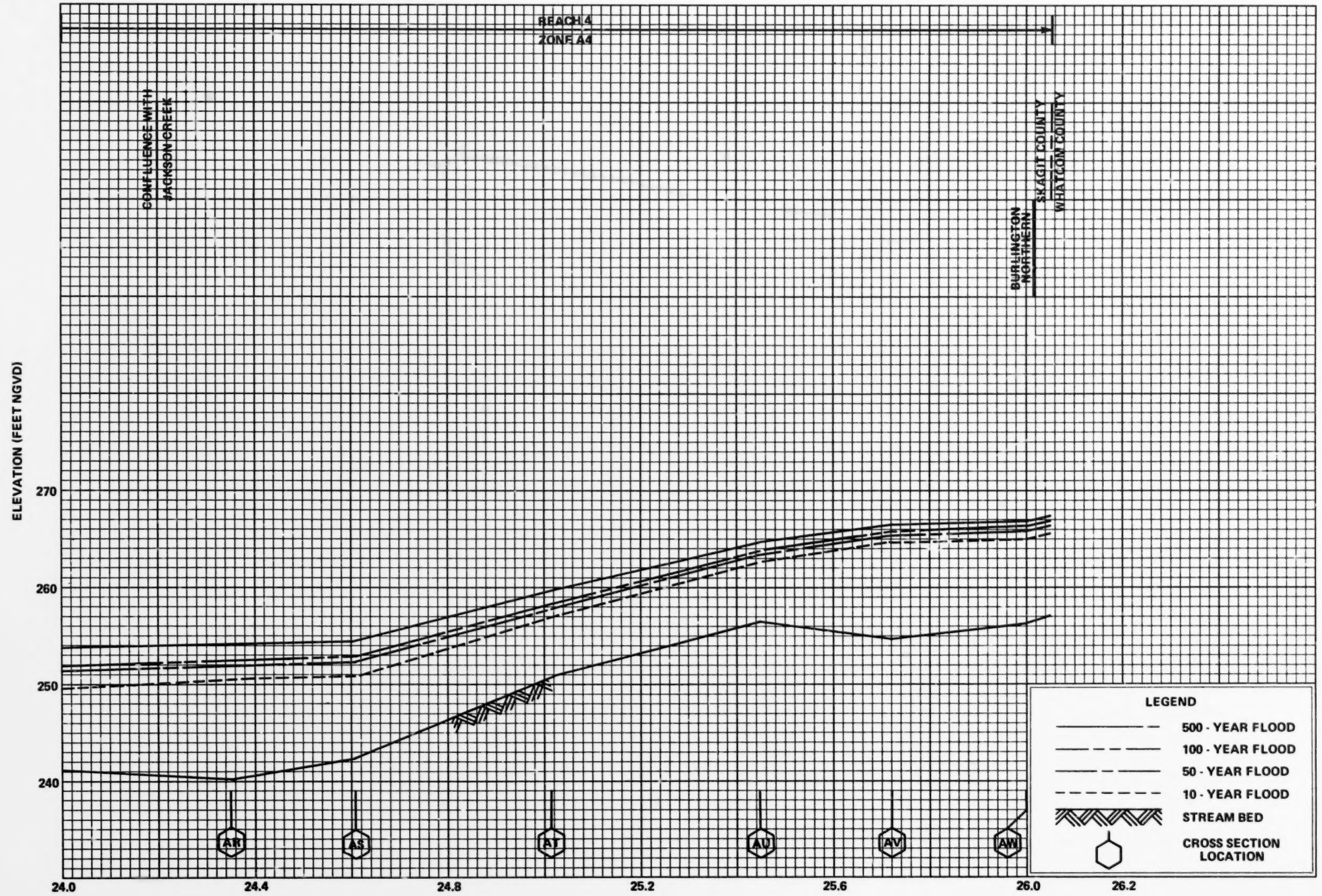
FLOOD PROFILES

SAMISH RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

SKAGIT COUNTY, WA
(UNINCORPORATED AREAS)

60P



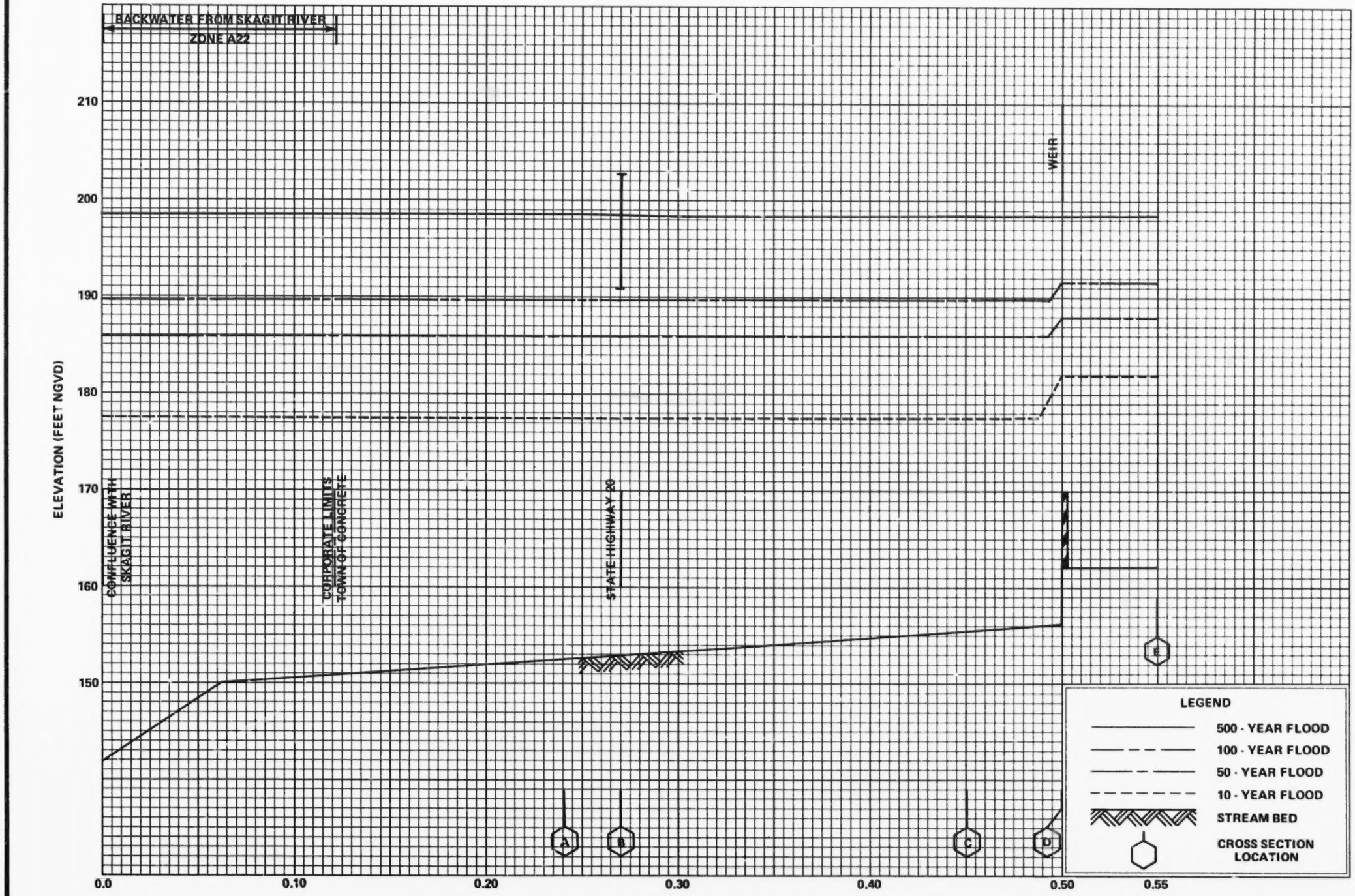
FLOOD PROFILES

SAMISH RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

SKAGIT COUNTY, WA
(UNINCORPORATED AREAS)

61P



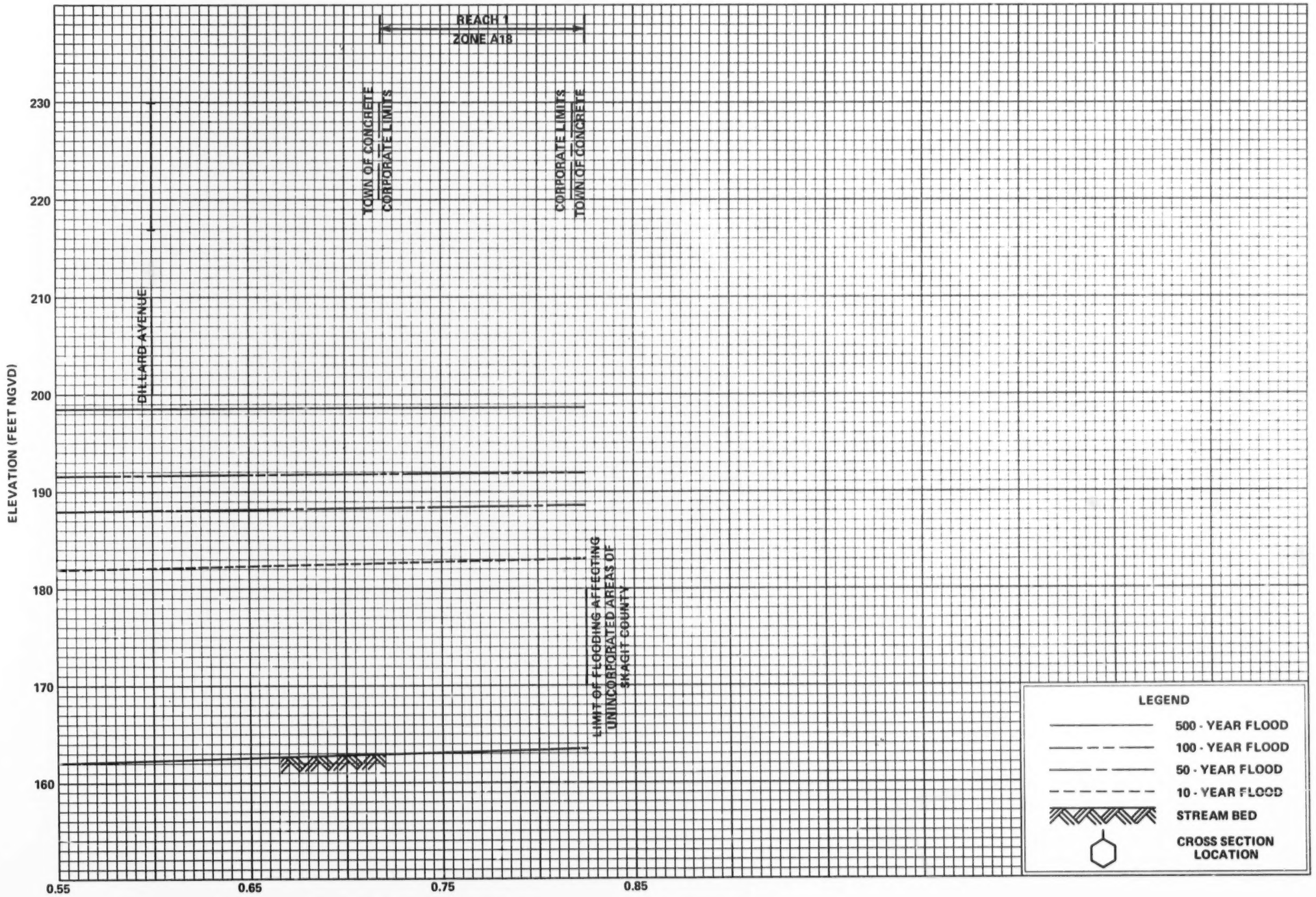
FLOOD PROFILES

BAKER RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

SKAGIT COUNTY, WA
(UNINCORPORATED AREAS)

62P



FLOOD PROFILES

BAKER RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

SKAGIT COUNTY, WA
(UNINCORPORATED AREAS)

63P